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JULY 1951
VOLUME 54 NUMBER 1

Published Monthly by
AMERICAN MEDICAL ASSOCIATION
535 NORTH DEARBORN STREET • CHICAGO 10, ILLINOIS

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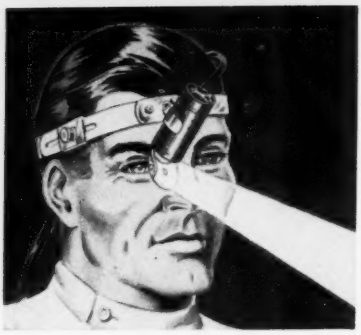

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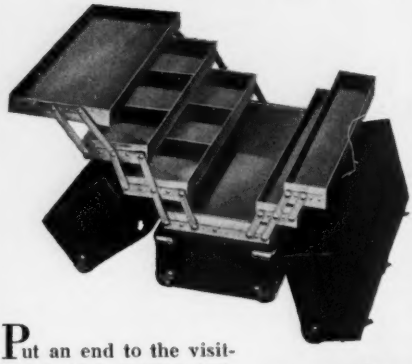

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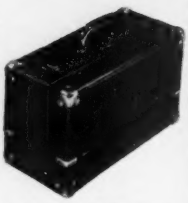

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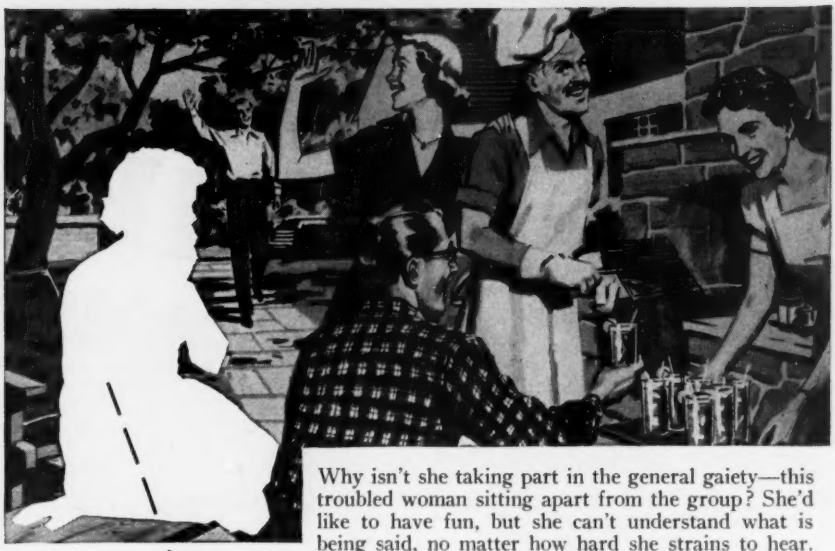

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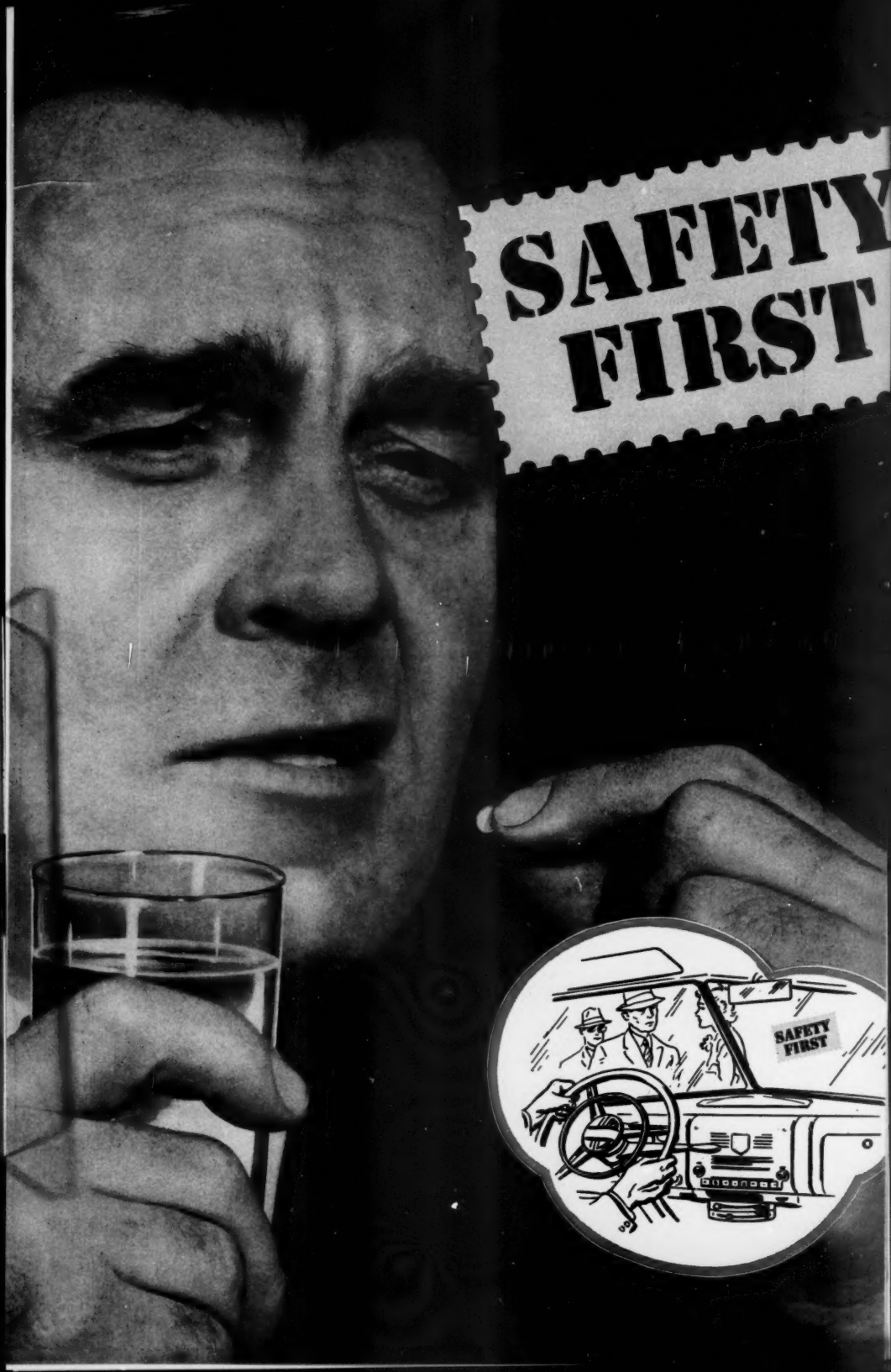
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CONTENTS

PAGE

Life of Alfonso Corti. EGON V. ULLMAN, M.D., PORTLAND, ORE. 1

Laryngocele. JOHN J. O'KEEFE, M.D., PHILADELPHIA 29

Laryngeal Obstruction Due to Antibiotic Therapy. ORRIN E. ANDERSON, M.D., NEW YORK 34

Functional Deafness. FREDERICK HARBERT, M.D., AND JOSEPH SATALOFF, M.D., PHILADELPHIA 38

Transtympanic Injection of Anesthetics for the Treatment of Ménière's Syndrome. MATTHEW S. ERSNER, M.D.; E. A. SPIEGEL, M.D., AND MAURICE H. ALEXANDER, M.D., PHILADELPHIA 43

Osteoma of the Maxillary Sinuses: Report of a Case. MILOVAN ĆURKOVIĆ, M.D., ZAGREB, YUGOSLAVIA 53

CASE REPORTS:

Lymphosarcoma of the Tonsil: Review of Literature and Report of Two Cases. OTTO C. HIRST, M.D., AND RICHARD A. CHARLAND, M.D., PHILADELPHIA 60

Laryngeal Histoplasmosis. WILLIAM F. HULSE, M.D., CLEVELAND 65

OTOSCLEROSIS:

An Index of the Literature with Abstracts for 1948 and 1949. EDMUND P. FOWLER, M.D., NEW YORK 68

DIRECTORY OF OTOLARYNGOLOGICAL SOCIETIES 114

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Communications regarding subscriptions, reprints, etc., should be addressed, A. M. A. ARCHIVES OF OTOLARYNGOLOGY, American Medical Association, 535 North Dearborn Street, Chicago 10.

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VOLUME 54 JULY 1951 NUMBER 1

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LIFE OF ALFONSO CORTI

EGON V. ULLMAN, M.D.
PORTLAND, ORE.

AUTHOR'S NOTE

The kind assistance and cooperation of Dr. Franco Arese, of Osnago, province Como, in Italy, was what made possible this article on Alfonso Corti, the anatomist, whose grandnephew he is. In answer to my request for new or unpublished material on his uncle's life, Dr. Arese sent photographs, personal letters, documents, with permission to reproduce them as I saw fit, and, as a gift to me, a stranger, one of the very rare reprints of Corti's doctor's thesis. He also sent a chronological table of the chief happenings of his renowned relative's life, by painstaking research illuminating those periods which had hitherto been shadowy or of which nothing was known. Owing to his efforts, for the first time a veracious and detailed biographical report, though brief, of the great Italian scientist was possible, and I must be ever indebted to Dr. Arese for his help.

Miss Bertha Hallam and her staff, of the Oregon Medical School Library, for their patience, aid and courtesy, also deserve my gratitude. I hereby tender it, thinking myself lucky indeed to have such an institution, staffed by such attendants, so close at hand.

FOREWORD

IN JUNE 1951, it will be one hundred years since Alfonso Corti published his "Recherches sur l'organe de l'ouie des mammifères." With this work his fame as an anatomist was established; the name of Corti is known today to every student of the natural sciences. "Corti's organ" is as familiar a term as "retina." Corti laid the foundation for all study of the anatomy and physiology of the ear and paved the way for the development of modern acoustics. He then, however, after 13 years' intensive work in science, abandoned his career (not a single mention was made in his last will and testament of his valuable scientific papers or how to dispose of them) and retired to the country for the obscure life of a rich and titled landowner.

This fact, perhaps, coupled with the supposition that his early life was as uneventful as that of his late maturity, discouraged biographical writers from setting down the history of his life and work. Thus it is that the man himself is practically unknown. Only one biography, if it can be called so, has been compiled to date, "La vita e l'opera di Alfonso Corti," by Bruno Pincherle, 1932, and this has not been published in an English translation. Arturo Castiglioni in his great "A History of Medicine," 1941, gives his countryman a scant five and one-half lines.

On the occasion of the centennial of the publication of Alfonso Corti's discovery, it seems but fitting that some praise is due his memory and that the story of his existence and firm endeavor should be presented, with as many new facets as research could uncover, to the American student.

LIFE

When Beatrice Malaspina di Carbonara, Marchesa di Corti, sent her serving-maid to wake her husband before daylight on June 15, 1822, her labor was almost over. The Marchese di Corti, Gaspar Giuseppe, would not, therefore, be put to the annoyance of a long wait to see his first-born child. The moment was chosen with care by the midwife in attendance and the weary Marchesa so that the latter's illustrous spouse would neither be exposed to a tedium of waiting nor miss the joy of hearing his child's first cry. God be thanked, breathed the lady, he was spared both discomfort and disappointment that moon-filled summer night, for no sooner did he enter the room than his son did likewise, Alfonso Giacomo Gaspare, Marchese di Corti di San Stefano Belbo.

That morning all the great house with its eighty rooms and two score servants buzzed like a beehive; the Marchese's vast fields, orchards and vineyards, which stretched as far as the eye could see in every direction, echoed with the shouts and laughter of happy workers. The Grand Signore had his wish, a son, and no retainer on the rich estate of Gambarana but rejoiced with him. Beatrice Malaspina, Marchesa di Corti, had to ask that her spacious windows be closed, and she sweltered in her chamber the rest of that day, thinking quiet preferable to the cooling breeze laden with the perfume of oranges.

More important things had happened, and would happen, that year of our Lord 1822. In America the Monroe Doctrine was proclaimed; an English poet named Shelley immortally drowned in Italian waters; Beethoven was at work on his Ninth Symphony, and Brazil and Greece declared themselves independent nations. Yet the birth of this child was important enough (not alone to his proud parents), for he would become the man who would lay the cornerstone of modern otology and acoustics, without which the structure could not stand.

The Corti family was old indeed. A young nobleman bearing its name was present in chains when the conqueror Henry II rode into the city of Pavia. Another was a Ghibelline castellan; another, a friend at court to Galeazzo, Charles IV's vicar. A Corti fought in the triumphant battle against the invading Prince Thomas of Savoy, and young Alfonso's grandfather had taken up his sword against Napoleon. His forebears were not only men at arms and courtiers, however. Fond of the arts and the pursuits of intellect, they were as often scholars and physicians, and in Pavia it came to be said: "All Cortis are born to be doctors." The historian Guazzo wrote of Matteo Corti, physician to Pope Clement VII and Cosimo I, professor of medicine at Padua, Pavia and Bologna, that he could be compared only with Hippocrates and Galen.

The worshipful Marchese had other plans than medicine for his first-born son. What they were we do not know specifically, but as the child grew older and in his studies with priests and tutors began to excel in those subjects which foretold the bent of his mind and where the interest of his heart would lie, the father in fervent unease tried to turn him from the natural sciences, zoology, botany and physics, which the boy loved, and make him substitute the study of the humanities. In this field, thought the parent, not only would he add to the name of Corti his own measure of authority and renown but in so doing would enhance his mother's name as well, Malaspini, from which family several lauded historians had come.

"Glory and eminence," said the Marchese, "these I would have my son attain."

"And so he shall, father," promised young Alfonso, "but in his own way."

As the years went on, these two, father and son, became more and more at cross purposes. The Marchese began to set his hopes less upon his eldest child, of whom he could not think without bitterness and disillusion, and more upon his other son, Luigi, born the year after Alfonso. The last named, from the beginning, was a *visuel* (like Goethe, of whom his friend Herder said, "Everything is so looked at with you!") who could never see enough.

His father said, "Do what you will! It is no affair of mine!" but his mother blessed him, and at the age of 19 he left Gambarana and entered the university at Pavia. Famous and great physicians had taught at this school—Peter Frank, once Napoleon's medical advisor (to whom the Little Corporal while in the bathtub boasted, "See the pimples on my back! See how fat I am!"); Lazzarro Spallanzzani, physiologist next in fame to Haller (who died feeling his own pulse), and Anton Scarpa, surgeon, remembered for Scarpa's Triangle—but in the year 1841, when Alfonso Corti enrolled there, there was but one man at the University of Pavia who showed signs of genius and originality. This was the great Bartolomeo Panizza, professor of anatomy, who struck out for himself in the new field of histology. Under him, the first scientist in Italy to give a course in microscopic anatomy, the young Marchese dissected his first specimen of the membranous labyrinth. Perhaps it is not fair to say there was only one great man at Pavia, for Mauro Rusconi was a lasting influence on Alfonso Corti. As irascible as warmhearted, blowing as hot as cold, Rusconi, embryologist and comparative anatomist whose suasive enthusiasm for his subject and profound knowledge of it had brought and would bring so many young men to his feet, spoke, and Corti listened. He listened so well that within the year he had learned all that Rusconi had to teach.

He was 23 years old when he left Pavia and set out by coach on a journey that was to last, with stops by the way, eleven years. It was winter, a chill wind sent the last few orphaned leaves a-flying, but the sun shone, and the first of May could not have suited the young man better. He went to Milan, that garden with its rows of mulberry and poplar trees on the little river Olona, and in the freezing weather surveyed the palaces, the third largest cathedral in Europe, tombs, crypts, the town moat, the library and picture gallaries; but a few days sufficed for these wonders, and he went on to Pisa. Here, what shortened his breath and widened his eyes was not the black and white marble churches, the inadvertent campanile, or "leaning tower," or even the holy ground of Campo Santo mixed with half a hundred shiploads of earth from Calvary. This was left for the *gabinetto anatomico*, the first real collection of anatomical specimens he had ever seen, to do, and it engrossed him for days. In Pisa, he purchased, with that delight a violinist feels when buying his first famed violin, a microscope with achromatic and compound lenses, and thereafter, when packing and unpacking his luggage, it was always his treasured tool he looked to first, as though it were a toy by Cellini.

His was not a tour "to see the world!" Earnest and impatient Corti had not time for that. He was on his way somewhere, and that place was Vienna; so he left Pisa, left Trieste and Graz, too, and made his way with what haste he could over bad roads in winter weather to the city known beyond others then for its university and medical faculty. He did not love "Alt-Wien," full of bells, waltzes,

spies and beauty. He was never to love either the city or its "frivolous, non-political, discontented and easy-going" inhabitants (for was not Austria the subjector of his country?), but the first sight of St. Stephen's needle-pointed steeple set his heart pounding.

No lilacs, now, at this time of year, to charm the senses. Snow lay thick upon the baroque roofs, and the cobblestone streets were slick with muddy snow. Cold, dull and dirty ran the Danube canal, and a sky to match it swirled overhead, low as a parlor ceiling. But one season was as another to the young enthusiast. Cheerfully he took a lodging on the Graben, with no concern which way it looked or upon what prospect, and cheerfully settled into it, pleased alike with the comfort and inconvenience it equally afforded.

The morning after his arrival found him in the Old University, located at the Universitätsplatz, before the high counter of the registrar who stood behind it full

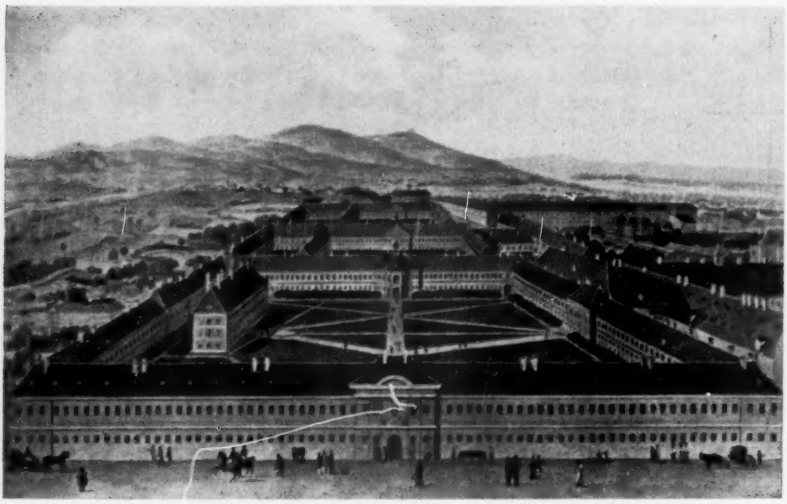


Fig. 1.—Allgemeines Krankenhaus in the early nineteenth century.

of gravity and importance. "I wish to register here," he said, "to take my degree in medicine." He spoke a shy foreign German, only enough to make himself understood. The registrar nodded soberly and reached for the credentials of the dark plump young man. He studied them, scratching his bearded cheek. "Four years study in Pavia," he said. "You wish —?"

"To finish my studies and take my degree," Corti repeated eagerly.

Registering was a lengthy business, but it was finally done. With his registration book in his pocket, bulky as a passport, and with the information that he would have to take but four clinical courses, Corti walked back to his rooms in great satisfaction. He had asked where the Anatomical Institute might be and had been told by the registrar that it was but a short distance away in another building. The man had pointed airily to his left, saying, "In that direction," and Corti had turned his head as though he might see through the brick wall a palace fair as in a dream.

But that was the best the university had to offer him, and so, as the child saves the frosting till last, he planned to visit it and present himself to the idol who reigned there only when all the mundane arrangements for academic work had been made and a routine established. Next day he went to the two thousand bed Allgemeine Krankenhaus, the largest general hospital in Europe. Of gray stone, low, unadorned, forbidding, endlessly long, when Corti approached it he thought it seemed more like a barracks or prison than anything else. Many uniformed men upon the Alserstrasse in front of it, walking stiffly and self consciously or riding horses as vainglorious as themselves, added to this illusion, and the young foreigner felt a heart-sinking sense of insularity and what was almost a reluctance to enter the large well guarded door. Once inside, however, this feeling passed, and he looked about him with interest.

He took four courses his first semester: medicine, under Professor Skoda; surgery, under Professor Schuh; dermatology, under its creator as a sound specialty based on pathological anatomy, Professor von Hebra, as noted then for his stinging wit as he would later be for his great atlas of cutaneous diseases, and obstetrics under that singular and Christlike man, Dr. Semmelweis, who was to suffer his own kind of crucifixion and ultimate salvation in madness.

Within a week or two Corti found that he could pursue these studies and yet have time for the work that meant most to him, and so he hurried back to the University and presented himself at the Anatomical Institute. Would the august Prof. Josef Hyrtl really see, talk to and consent to guide him in the anatomical quests he longed to follow? This and a hundred other questions he asked himself while waiting to be ushered into the great man's presence. When picturing this moment, as he had done over and over, not once did he imagine he would have the inexpressible pleasure of being addressed in his own tongue, but Professor Hyrtl, smiling broadly, said in Italian, "Welcome to Vienna, Marchese." The anatomist, it was said, could speak twelve languages—all with a Hungarian accent—and never did more welcome sounds fall upon Corti's ear than these simple words. After the amenities were over and polite inquiries made as to the activities and well-being of those teachers at Pavia who were known to him personally or through their work, Professor Hyrtl (whose handsome gentility and look of youth—he was only 10 years older than his visitor—suited more a gilded court circle than the dismal surroundings of the institute) asked, "What, my dear friend, are you doing here?"

"I am getting my doctor's degree," Corti said, "but I should like to study some more anatomy. That is what I came here for."

Hyrtl stared at him for a moment. "Good," he said, "very good. But why just this work? What leads you to it?"

The young Italian did not hesitate. "The studies I did under Professor Rusconi," he said, "interested me so much that I wish to continue them and learn all I am capable of learning under the greatest teacher now living in the world—yourself, honored sir."

"How long did you study?"

"Four years, Professor."

"Studies that comprised what?"

"General anatomy and microscopy, sir."

"Are you any good at it?" Hyrtl asked teasingly.

For answer, young Corti, his round cheeks deepening in color, took from his pocket and handed across the desk two letters: one from Panizza and one from Rusconi. Hyrtl read them, pushing his gold-rimmed glasses tighter against the bridge of his nose. He looked up smiling. "Well!" he said. "I see we shall have to find something to keep you busy. If you had your choice—?"

"Dissecting, if you please."

To his assistant, then summoned, who came in, Professor Hyrtl said, "Dr. Friedlowsky, this is the Marchese Corti, who has come from Pavia to study with us. Assign him some dissection work."

Large and drafty, ugly to the sight, the Anatomical Institute was in a former gun and ammunition factory. On the ground floor were professors' rooms, a small

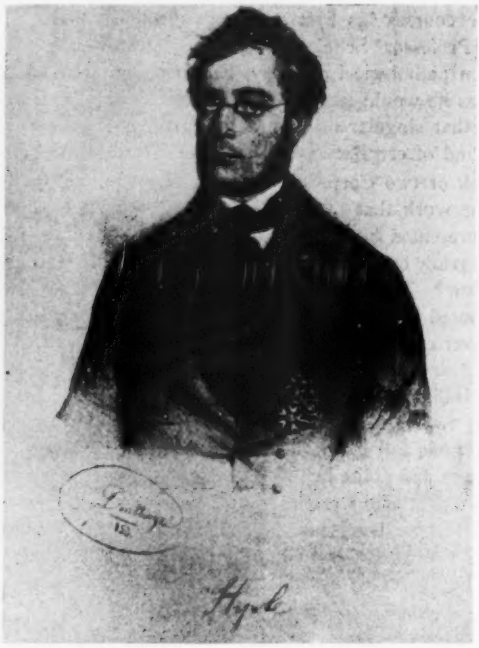


Fig. 2.—Josef Hyrtl, from a photograph made in 1853.

and unhandy library full of some 2,000 valuable or worthless works, a long microscopy room with five or six microscopes down a narrow table and a museum that was the wonder of the whole world. Three years later, when this building and all that adorned it went up in smoke during the riots of the revolution (a ferocious uprising of students and workmen soon quelled by the Emperor's troops but winning certain significant victories for the insurgents, not least among them a bettering of university conditions), Professor Hyrtl wrote of the loss of this museum with tears, and when later he included the following in a speech to the Imperial Academy of Sciences it was all he could do to maintain his poise:

In the tragic events which have preceded the return of the legal order in our city I lost all my possessions. When I returned from the improvised hospital, where I was confined for some

days, to my home to change my shirt which was dirty from blood, I found the smoking ruins of what had once been my workshop. I always wanted to be enough of a philosopher to be able to resign myself to the loss of earthly possessions . . . but the destruction of my library, my microscopic specimen, manuscripts and drawings was such a blow that it brought me almost to the brink of despair . . . As for the destroyed material, I can say that the collection of injected microscopic specimens was unique of its kind and I fear it will never be possible to bring it back again to that degree of perfection which distinguished it. It comprised about 5,000 items of the vasculary system of all the organs of all indigenous and exotic animals I was able to secure in 15 years of labor, and it was organized in such a way that every order and every tissue could be studied in relation to the development of the vessels, starting with the mollusci and cartilaginous fishes and going upward through all species and classes, to man. I feel this loss the more deeply because the great amount of duplicates that I possessed and their continuous renewal put me, as it were, in a position so that I could exchange specimen with all the anatomists of the world. Not less precious was my collection of organs of hearing. From mice to the gigantic species of pachydermics, there was no animal of which I did not have representative specimen of the osseous organ of hearing, complete and finished. Every anatomist who is interested in technical problems knows what that means. The anatomical collection of the human auditory apparatus alone contained 90

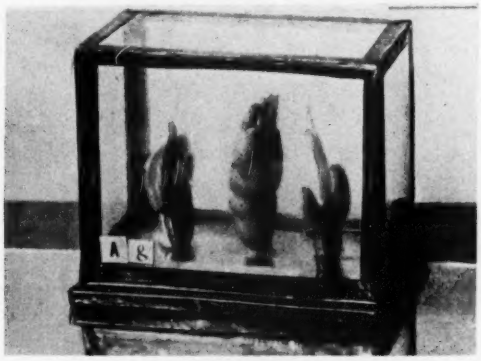


Fig. 3.—Three specimens of the heart of the Psammosaurus griseus, prepared by Dr. Alfonso Corti for the collection in the Vienna Anatomical Institute.

specimen and represented the development of the labyrinth from a third month old embryo up to a 70 year old human; moreover, there were auditory organs of monstrosities, of deaf mutes, different human races, nor were the auditory organs of several mummies missing. I shall lament all my life . . . this loss, because only once, and then only by the greatest good fortune, can a man hope to gather together such a collection.

Downstairs, in the deep cellar under low vaulted ceilings, were the clammy gas-lit dissecting chambers. Behind a locked door, guarded by a misshapen old man, was the small shallow tank full of chlorinated water where the precious corpses lay submerged, waiting the hook upon the wooden pole in the hands of the student-fisherman.

To this place, when his other tasks were done, Corti sped as another young man might speed to his mistress, the theater, a concert or a costume ball. Here, four or five hours a day—longer, if possible—six days a week, he worked. Within a year and a half he had dissected a dozen cadavers, and 24 of his specimens were incorporated into the personal collection of Hyrtl, that fabulous amassment so soon to be lost. Nights, in his new lodging in the Court of the Black Spaniard, he

studied German until the book dropped from his hands and the ever-strange-sounding words died upon his lips in a whisper.

The "sweet girls" of Vienna, famed in song and story! Corti had no time for them, though they clustered like the lilacs, or for lazy protracted visits to the coffee houses, even the celebrated Cafe Griensteidl, where the literati, scientists and musicians gathered, or the aristocratic Daun or the amusing Cafe Drei Läufer. When summer came, very few were his walks for pleasure, either to the bosky Vienna Woods, not then immortalized in music, or out along the Schönbrunn way,

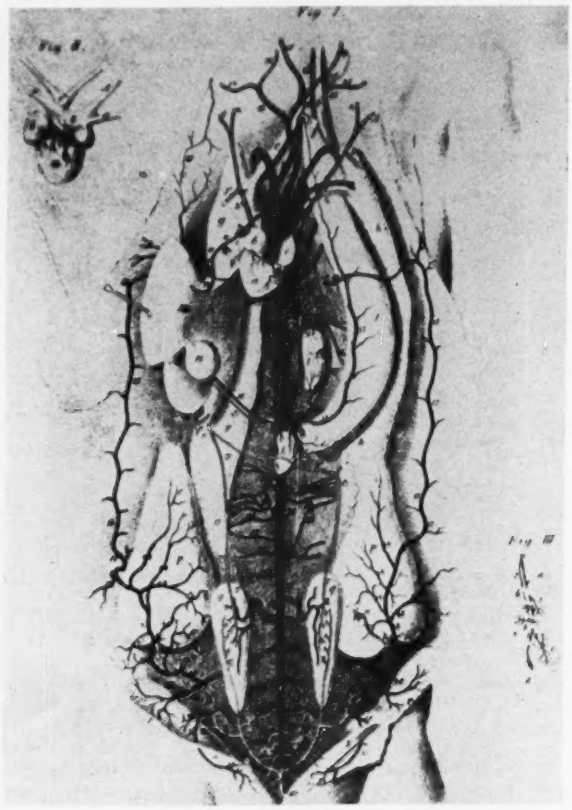


Fig. 4.—Drawing of the vascular system of the trunk of the Psammosaurus, by Corti.

where all the fields were green. He forewent the diversion of social gatherings among his own class, where the elderly disported themselves as solemnly as judges, young women affected stark white faces, jewel-toned velvets and "Renaissance" hair styles, and young men as wan as their sisters (pallor being then in high fashion) wore Tintoretto beards, quizzical eyebrows and coats so tight they could scarcely contrive to bow in them. He went to Mass, however, and never a Sunday morning but found him in St. Michael's.

On a sweltering day, Aug. 6, 1847, he got his doctor's degree and as a man may enter retirement with the happy expectation that he can now give his undivided attention to some cherished pursuit, hitherto merely a hobby, so Corti made plans to devote his whole time to anatomy and those lectures of Hyrtl which illuminated the subject like the sun a gloomy fortress. He was then engaged in writing his doctor's thesis, "De systemate vasorum Psammosauri grisei," to be dedicated to this peerless teacher. When it became available, on Nov. 29, 1847, he applied for the job of second prosector of the Institute, sending in this petition:

Very excellent Vice Director!

The undersigned has taken the liberty of asking that the position of second prosector at the Institute for Anatomy of the University of Vienna be kindly granted him and rests his application on the following facts:

1. He is, as appears from the enclosed birth certificate, of Catholic religion.

2. He has finished the course of medical-surgical studies required by the faculty, as proven by the enclosed certification; the grades obtained at the fifth year are explained by the difficulties that the German language presented for the undersigned, since this was his first year in Vienna. He received his medical degree of Doctor of Medicine at the University of Vienna.

3. He had dedicated himself to the study of Medicine only because of his predilection for human and comparative anatomy, and, in the first four years, has studied these subjects under the guidance of Prof. Panizza and Prof. Rusconi, and has prepared in these years specimens for the museum of anatomy at Pavia. He thus acquired the special attention and earned the friendship of these professors. In order to perfect himself in this science the undersigned came to Vienna two years ago and has lost by this act the possibility of obtaining a position in Pavia which had been promised him privately. In these past two years he has dedicated himself with great fervor, under Prof. Hyrtl, to the study of anatomy, both human and comparative, as Prof. Hyrtl will attest. He now takes the liberty, as far as his skill in anatomical dissection is concerned, to refer to his dissertation: *De systemate vasorum Psammosauri grisei.*

4. During the past two years he has executed 12 specimens of anatomy and 24 of comparative anatomy, all of which have been incorporated in the collection of the Anatomical Museum of Vienna. Prof. Hyrtl can give testimony to their worth. He also has collected for this museum several sea animals from the coast of Italy, which he obtained during a trip he made for this special purpose.

5. Moreover, in this time and also during the current year, he has collaborated in the execution of preparations for the public lectures of anatomy.

6. Meanwhile, he has dedicated himself with maximum enthusiasm to the study of the German language and now dares say that he is sufficiently proficient in it so that it no longer confronts him with difficulties. He feels that he can now conveniently fill the position if it were granted him.

7. He can prove his progress in the German language also with his next publication, to come out very soon, written in German, on several anomalies found by him in muscles, nerves and blood vessels.

8. In order to be able to satisfy his love for this science, and to consecrate his whole life to it, he has had to overcome obstacles thrown in his path, has sacrificed ties with his family and abandoned his country. All this, to perfect himself at the University which is now the spot where science flowers. Animated by hope for it and with a deep conviction that in this position lies the best opportunity for perfection in Anatomy and Physiology, he dares repeat his prayer with the promise that if the position be granted him, he will take great care always to show himself worthy of the favor with indefatigable endeavor and uninterrupted work.

That Hyrtl was eager to give him the post may be seen from this excerpt from his written opinion of the young candidate:

Because of the really rare devotion of the candidate to the natural sciences and particularly to anatomy and because of his spiritual talents and his good will, it is to be expected that, if

the position of second prosector without pay be granted to him, he will fulfill its duties to the satisfaction of all parties concerned . . .

The twenty-five years between 1825 and the half-century mark was a time of extraordinary interest and work in the anatomy of the sensory end organs. Henry Gray, of London, Purkinje, in Prague, Johannes Mueller, in Berlin, the Italian, Pacini, to name but a few, had published arresting papers on their anatomical studies of the retina and the organs of touch. Hyrtl was then engaged in his

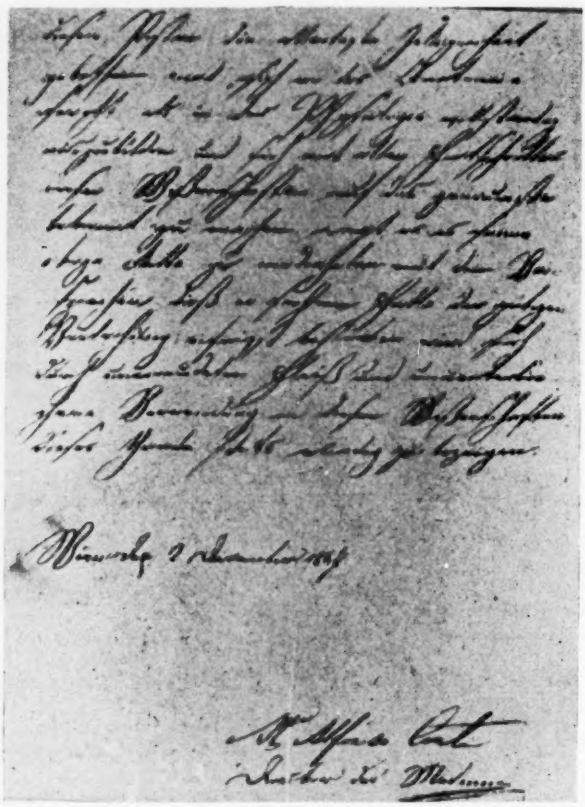


Fig. 5.—Corti applies for position of second prosector at the Vienna Anatomical Institute.

comparative studies of the osseous labyrinth, and the Marchese followed his work with deep interest. So far, only Todd, of England, and the German, Huschke, had done research which had become known on this subject.

One afternoon Corti had occasion to speak with Hyrtl and was shown by Dr. Friedlowsky into the small wainscoted professor's room he occupied. There he found the great teacher gazing at a beautiful specimen, two crosscuts through a petrous bone, one showing the cochlea, one the labyrinth, gracefully mounted with

wax on an oval wood base. "Come in, my friend," Hyrtl said over his shoulder, recognizing the soft footsteps.

Corti approached and stared in admiration. "What a wonderful work!" he could not help exclaiming.

A smile flitted across the anatomist's lips as he set the specimen down on the table littered with manuscripts, magnifying glasses and a tray full of petrous bones of sundry animals. He turned his head and glanced upward at the young Italian. "You speak as if it were a finished thing," he said, "like a church, a painting or a musical composition."

"Is it not, Herr Professor?"

Hyrtle rose, sighing. "Why, no," he said. "I have scarcely begun it." He caught the half-smile on his visitor's face. "You smile as if in disbelief," he went on, "but I am in dead earnest. I have been working for fifteen years with the ear —and I would be embarrassed if someone were to confront me with the question. What does a man hear with? for I do not know!" He picked up the petrous bone of a cat and stared down at it idly, tossing it in his palm. "Is it in the semicircular canals? If so, where? Is it in the cochlea? If so,—?"

In agreement with this last, Corti nodded his head. "Panizza took a wax model to London and showed it to Bowman. Bowman said he thought the sensory epithelium must be there, in the cochlea. Is there no way to ascertain whether it is or not? Have you tried?" It was a bolder and more impudent question than he meant to ask, and he flushed brightly to hear his own words.

"Of course," Hyrtl said, unoffended. "But trying is not succeeding, as many a man has learned to his life's disappointment."

"What are the real difficulties?"

"It perishes," the anatomist said, dropping the small bone to the table, "before the eye can see it. It is the most maddening thing! Until we can conserve a fresh specimen long enough to get it under the microscope, we won't be able to accomplish much. Look, there's a job for you," he added, observing the look of intense interest on Corti's face. "Why don't you try to unravel the big secret?"

Next day Corti, who had hardly slept the night before, so keen was his anticipation, killed a guinea pig and dissected the petrous bone of one of the embryos of her litter. This, for one so skilled as himself, was a job of half an hour. Then he sliced it with the cherished new microtome, a tool devised that year (1847) by Purkinje and newly acquired by Hyrtl for the institute, which task, by working very rapidly, took him fifteen minutes. He placed a slice between glass, put a drop of cedar oil on top of it and slid it under the microscope. The winter sun that had gaily illuminated the scene decided to lend no more assistance and went behind a cloud, withdrawing a long beam of yellow light. Muttering with exasperation and after a quick look outside to see whether there was any chance of the sun's reappearance, he hastily put the microscope under the small unsteady gaslight and began to manipulate the condensor. It was, alas, so dark! At that instant sunlight flooded the room, and he rushed to bring the microscope close to the window again, dragging his stool behind him. But he had no more than time enough to put his eye to the objective when Phoebus once more vanished. Trusting the sun no further that morning, he put the microscope under the gas light, cursing its inadequacy, and settled down to look at his fine specimen—a worthless, shapeless,

unrecognizable mass of decomposed matter! He groaned aloud. It had taken almost two hours (he looked at his watch) to get the specimen from the embryo, prepare and get it under the lens for study. Too long! Quick as he was, he would

Fig. 6.—Dissecting room in Vienna where Corti worked.

Fig. 7.—The Anatomical Institute of Würzburg, Bavaria.

have to learn how to work still more quickly. And then, the illumination. It had to be such that he could depend upon it, not an on-again-off-again thing that tantalized one beyond endurance. Speed, he thought—speed and light—little suspecting that neither of these was to be the answer to the riddle.

On December 29, when he finally got his appointment as second prosector, he liked it as little as, after twenty years, a man will like some special gift he coveted in childhood. His new endeavor had in the meantime become his sole interest, and he was jealous of every moment which had to be devoted to such routine duties as the quotidian dissecting with students, four hours each weekday, his duty of procuring cadavers (no easy matter, as the pathologists of the Krankenhaus, headed by Professor Rokitansky, seemed to want them all themselves!), preparing the exhibits

Fig. 8.—Rudolph Albert von Kölliker, from a drawing executed about 1850.

for Hyrtl's lectures, sometimes the work of many hours, and aiding in the cataloguing of his teacher's vast collection. Every free moment, however, during the day, and most evenings, in spite of the pain, slight now but persistent, of the arthritis that was to make a cripple of him before many years, he returned to the icy cellar rooms. There, until blind fatigue compelled him to give up, he worked at trying to demonstrate the soft parts embedded in the bony shell of the ear, a triumph he would not achieve until two long years had gone by.

An interruption came along then, more disturbing than the daily duties at which he had so much chafed. The revolution broke out! A week of the noise, disruption, roughhouse and palpable danger of this and he fled. Not only was the life and liberty of every foreigner in jeopardy, but, as he wrote in his farewell note to Hyrtl: "Inter arma, silent musae." (War comes, the Muses are still.) Besides, northern Italy at that propitious moment having risen against the usurper, Austria, his patriotism compelled him to join with his countrymen in their fight for freedom. After five months in Zurich, to which he fled from Vienna and where he continued, with Professor Valentin, his experimental studies on the ear and took up a new subject, the anatomy of the retina, he enlisted in the Italian army in Turin, Nov.

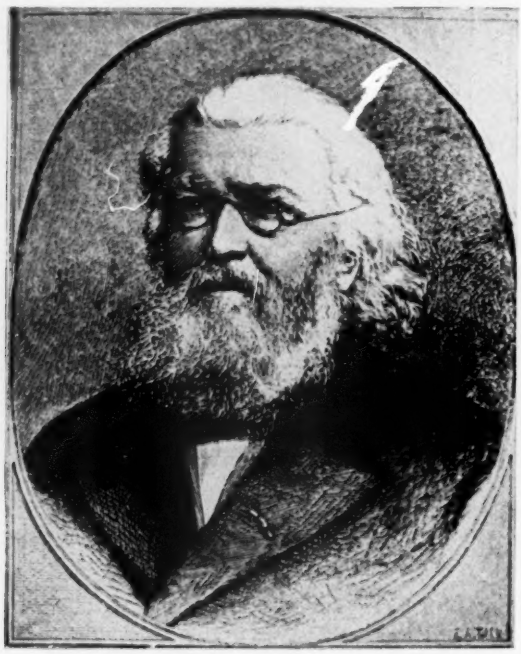


Fig. 9.—Prof. Pieter Harting, of Utrecht, Netherlands, who gave the answer to the riddle.

21, 1848, serving until February 1849, when Lombardy and Venice regained their independence.

This obligation taken care of, he could turn back to his work with an easy conscience and did so, going to Paris. His mother, young sister Emilia and youngest brother, Carlo, had sought refuge there the year before and taken up residence at 114 rue de l'Université, and he was happy to join them in their elegant roomy flat. He remained in Paris ten months, and it is not known what or where he studied, but his paper on the anatomy of the retina coming out in April 1850 three months after his departure from France, it may be conjectured that he was seriously at work much of the time, perhaps at the Institute of Anatomy of the Sorbonne. This valuable paper, "On the Anatomy of the Retina" (*Arch Anat.*,

Physiol. u. wissensch Med. 273-275, 1850), contains the description of a novel technique—that of allowing the specimens to lie in chromic acid for a quarter-year before staining them with carmine and examining them. By this method he proved that the sensory end cells seen in the retina were the beginning of the optic nerve.

He was in Würzburg, Bavaria, when this paper was published, where the most famous school of microscopy in Germany was then located. Würzburg itself, a quiet provincial town, was an attraction to the serious student; doubly so because the renowned microscopist Prof. Rudolph Kölliker had recently been appointed to the chair of microscopy at the school. This man was only five years

Fig. 10.—The Utrecht Observatorium Microscopicum.

older than Corti himself, but his gravity and solidity made him seem much older. It was said of him that he "knew more by direct personal observation of the microscopic structure of animals than anyone else who ever lived." However, his rare smiles showed one his modesty and great good will, and Corti soon felt at ease with him. Another famous man graced the faculty there: Heinrich Mueller, a scientist much discussed for his skill in demonstrating the retina. Here, throughout the pleasant summer days, the young Italian worked under the guidance of these two. His cherished endeavor to bring to sight the perishable parts of the ear had been temporarily set aside, because he was unable to find a workable technique, but he did not forget it while he continued work on the retina, which labor he hoped would benefit him in his search for the sensory end organ of the ear.

The first week of August, Mueller mentioned to Corti that Kölliker, then away, was going to visit Utrecht before he returned to Würzburg. "Why don't you pay a little visit to Utrecht, too, while he is there?" Mueller inquired. "The Observatorium Microscopicum is really something you should not miss."

Corti agreed that he should not and a few days later took the train to Utrecht, in the smallest province of the Netherlands. He felt, of course, a curiosity to meet Schröder van der Kolk and Pieter Harting, the histologists—no more than curiosity—little dreaming that the latter was to be (for him and his work) the most important man he would meet in all his life!

The Observatorium Microscopicum delighted him, and he wandered through it as through a pleasure dome. Kölliker, too, must have been greatly impressed, for on Sept. 4, 1850, he wrote to his friend, Dr. C. T. v. Siebold:

My Esteemed Friend,

To keep my promise, I am writing you about the most interesting things I have seen on my vacation, traveling through Holland and England. For a long time I have wanted to see Holland, the country in which anatomy took its roots and brought so many notable results, but I was always kept from going there by something or other that came up to prevent me. This autumn, though, while I was going to England, I suddenly, on an impulse, decided, the night of my arrival in Cologne, to visit Holland at last.

By steamboat and train I went to Arnheim and from there to Utrecht. The day following my arrival, I went to the Observatorium Microscopicum where I met with Schröder van der Kolk, Harting, Verloren and saw from Würzburg the young Piedemontese enthusiast for the natural sciences, the Marchese Corti, who was in Utrecht at the time, and whom you surely know from his writings on the vasculary system of the psammosaurus. I certainly felt in the midst of my element . . . in the large room where we were, I saw all the apparatus imaginable for microscopical research. What particularly attracted my attention and curiosity was a large cabinet full of microscopic specimen.

Harting . . . represents, as it were, microscopy in Utrecht, although he is not the only one working in this field. He directs the Institute (Observ. Microsc.) and is almost as rich as we are at Würzburg, because he owns ten microscopes in workable condition, and outdoes us in a large amount of other apparatuses, a collection of old microscopes, and his own personal collection. . . . Harting possesses the old microscopes of Muschenbrook and Van Deyl, a lens of Tulley and what above all touched my heart, a most beautiful microscope of Leuwenhoek with an enlargement of 27 diameters. I knew the magnifying devices of the first microscopes only from illustrations; therefore, I was quite impressed to see at least one of them. . . . Harting's work in vegetative and animal histology is known to you . . . he is working at present on microscopic studies of the anatomy and physiology of plants, perhaps as a supplement to Donders' Microscopy of Human Anatomy. He is now occupied with a microscopic collection which is the most beautiful ever seen. I wish . . . you could behold that huge cabinet with drawers and drawers full of microscopic specimen—six thousand of them!—comprising the anatomy of plants, animals and man, all catalogued and arranged in a wonderful order. The injected preparations stands out in such beauty. . . . Too, I have seen the most important part of Van der Koik's collection of pathological anatomy, and also admired the beautiful injections. He is working on the structure of the placenta and of the spinal medulla, and he showed me the specimen pertaining to this research. . . .

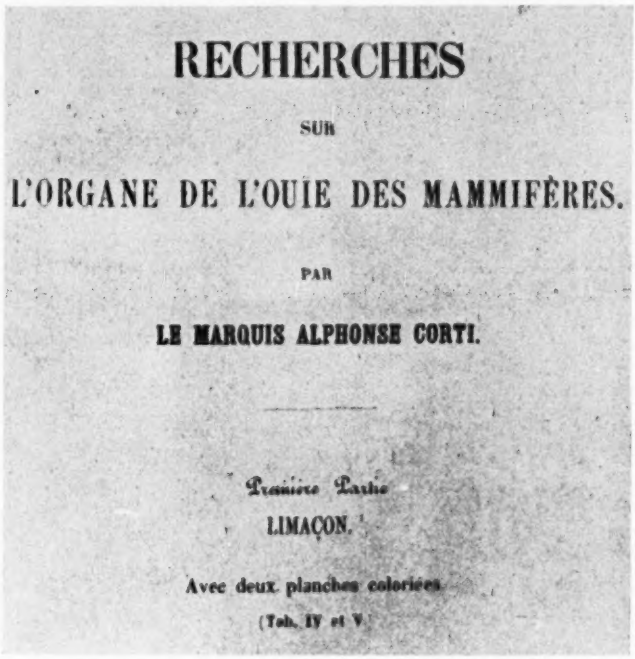
Now, how was Pieter Harting, with his remarkable physical resemblance to Karl Marx, how was that stolid man past middle age, equipped to play a role of such significance in the life of Alphonso Corti? They spent only a few hours in each other's company—it is possible that Corti had only one conversation with him—but during those brief hours, during that talk, Corti was given the answer to the riddle he had sought so long and so painfully, the secret that was to bestow immortality upon him. What was the answer? What was the secret?

Harting, Corti and two or three others were talking about the preservation of specimens in such a way that their cellular details could be distinguished under the microscope. "They have to be suspended in fluid," Harting said. "Then one may distinguish in perishable specimens those details which cannot otherwise be seen."

"Suspended in fluid." Corti clapped his hand to his forehead. "I never thought of that. . . ."

"What fluid?" someone asked.

"Why, any number," Harting replied. "Arsenic acid, distilled water with alcohol and sugar added, a solution of much diluted corrosive mercury, a strong sodium chloride or concentrated sugar solution. You understand that these are not


RECHERCHES

SUR

L'ORGANE DE L'OUIE DES MAMMIFÈRES.

PAR

LE MARQUIS ALPHONSE CORTI.

Première Partie

LIMAÇON.

Avec deux planches coloriées.

(Tab. IV et V.)

Fig. 11.—Title page of main work by Alfonso Corti.

interchangeable—one may be good to bring out epithelia, another nerve endings, another useful only for striation of muscles and so on."

Almost stammering in his eagerness, Corti inquired, "What solution do you think should be used to examine the membranous cochlea?"

Harting thought a moment, lower lip caught between thumb and forefinger. "Well," he said, "why don't you try diluted hydrochloric acid, or—perhaps better still—acetic acid?"

And there, very simply, was the answer! Not speed in preparation—not illumination. Merely to suspend the specimen in fluid. . . .

Back in Würzburg, Corti set feverishly to work and in a few days had made his first significant observation on the cochlea. He described the complicated

anatomy of the lamina spiralis in mammals. He saw that it carries bipolar globules, 0.15 microns in size, the nature of which he supposed to be ganglions and which he assumed continued into the dark-walled nerve fibers.

Three months after Corti's visit to Utrecht, Kölliker's handbook, "Mikroskopische Anatomie" came out, the foreword of which expressed gratitude to Corti

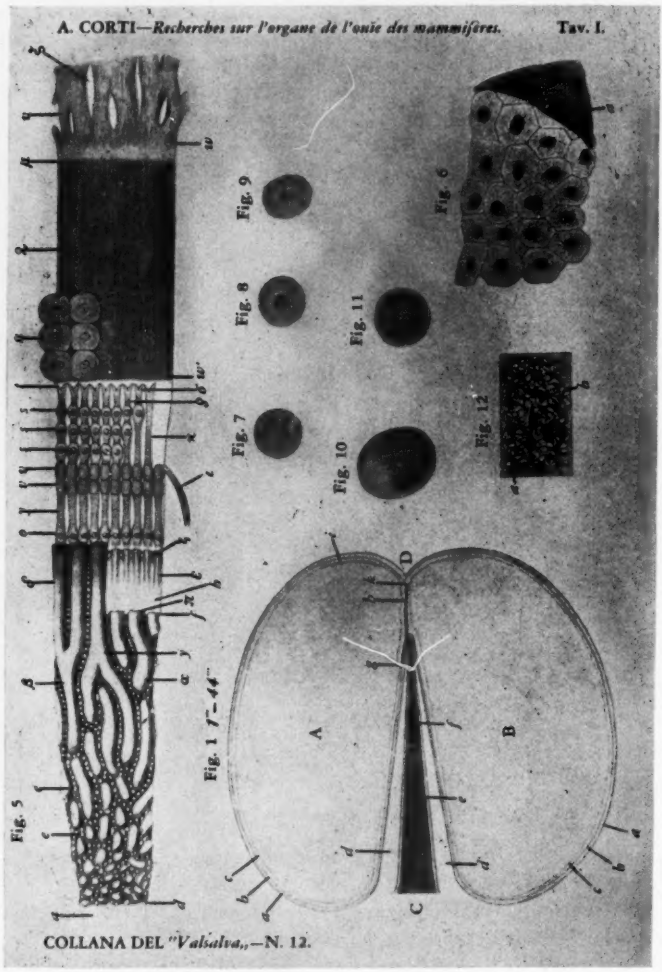


Fig. 12.—Plate I of Corti's main work.

for the help he had given by furnishing several drawings—the muscle of the heart and the muscle of the tongue of the frog, which latter has a "treelike" aspect, and a drawing, incorporated as figure 124 of his monograph. On page 210 he gave credit to Corti for the collaboration on subjects other than the cochlea, and on page

519 he described in some detail Corti's work on the acusticus. So the young anatomist must have been laboring like a Hercules.

Corti was not there when the monograph came out, for on Oct. 24, 1850, he returned to Paris, sending back many an affectionate glance, as the train pulled out of the station, to the placid little city in which he had finally attained his goal. There was much, much more to be done. More than a man could do in a long lifetime! He had dissected 20 specimens of the dog, cat, mouse and rat, but he wanted 200! He wanted the whole gamut of mammals! Once settled in Paris, he would add specimens of the chochlea of the bull, pig, lamb, rabbit, mole, squirrel and bat. Most important of all was man, but as he was to write later: "As far as the latter is concerned, I could not repeat my examinations because of the lack of fresh cadavers. I think I can do this work in the future," he added hopefully, "and will then render the results within another work on the vestibulum of mammals which I hope to get together in the early future. In man it is especially difficult to recognize all the tissues and structures because it is so very hard to obtain fresh specimens." He was never to publish such a work but did manage to do enough dissection and study on the cochlea of man to write in an appendix to his main work, "Recherches sur l'organe de l'ouie des mammifères": Part I (part II was projected but never written): "By and large, according to my observations, I found that the structures in man are very much the same as those in other mammals I had a chance to study and it is almost certain that the cochlea of man differs little from them in a general way."

The year of 1850 went past like a river flowing by his door at which he never looked, full of happenings of which he knew nothing. Honoré de Balzac died; in America, President Taylor died; a book called "Uncle Tom's Cabin" was published, and one called "The Scarlet Letter"; a man named Ibsen saw his play "Catalina" make an astonished celebrity of him; cholera broke out in the British Isles; the first international cable was sent from England to France; Victoria received a little present, the Kohinoor diamond; the Chinese discovered California, and Austria prepared for war against Prussia—all these things, and Corti, in his ivory tower, engrossed with work, paid them no heed. The year 1851 would go by that way too, with its events—the forming of the Triple Alliance against England; Britain's annexation of East India; civil war in Portugal; the deaths of the painter Turner and sad Mary Shelley—all meaning less to Corti than leaves blown from the trees. Little by little he got together his two hundred specimens, working at home and in the Sorbonne, and between times wrote the third of the four papers he was to publish, the one on which his fame rests.

It was first written in Italian and then translated by Corti himself into French. He sent it to the *Zeitschrift für wissenschaftliche Zoologie*, a Leipzig publication of small circulation among zoologists and little read by physicians, with a sigh that it would have so scant an audience, but he thought it the proper vehicle for a research report pertaining to animals. Kölliker, one of the editors, to whom he addressed it, saw it through publication. This good friend wrote soon after receipt of the paper, his letter dated March 19, 1851.

My dear Corti,

. . . I am busy with correcting the first section of your monograph, which contains the first part with the table of the diameters. You submitted 80 pages which will make about 32 when printed. Should your promised illustrations reach me within 10 days we could have it

ready for print this month. You will receive 150 reprints with special page numbers . . . sent to your Paris address as soon as possible. Your drawings will appear on 2 tables and will be reproduced in the same size as yours . . . will do my best with correcting and hope all will come out to your satisfaction.

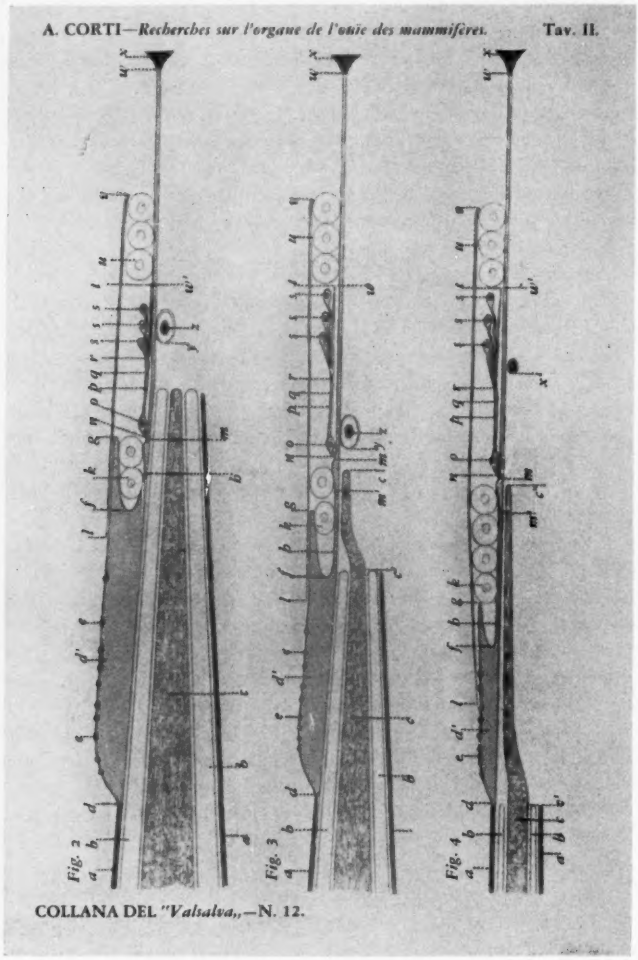


Fig. 13.—Plate II of Corti's main work.

This is my opinion . . . your work is *excellently done* and I feel assured that it will bring you honor from every side, the more so when we consider the tremendous difficulties of treating this subject. If the physiology of the ear ever comes into its own, it will only be after someone has studied the organ as diligently and capably as you have begun it. . . . I do not know if I will find everything as you did . . . but . . . judging by what I have seen so far in your specimen, I believe that you have observed truly and described correctly. One

thing remains to be wished for . . . the embryology . . . so that one can comprehend the meaning of the zona denticulata, et cetera. Maybe you will find time for that later! . . . believe me that I am ever your truly devoted,

A. Kölliker.

The following year Kölliker was to publish his famous "Handbuch der Gewebelehre des Menschen," and in it was to call what before he had termed "The Organ," the organ of Corti—Corti's organ—the name which was afterwards accepted by all men of science. He gave an exposition of the minutiae of Corti's organ, stating that Corti had discovered the ganglion of the cochlear nerve, the complicated cells of the organ itself, the tectorial membrane of the habenula sulcata and described for the first time the details of the lamina spiralis. Quite a tribute! Kölliker wrote:

I followed Corti in my description of the cochlea almost word for word, after having convinced myself of the exactness of the observations of this talented and astute researcher. In my latest investigations on the cochlea of man I found most things as Corti has pointed out for mammals and described so masterfully.

Kölliker was as enthusiastic in the second volume of the same work when it came out in 1854 and heaped still more praise upon the young Italian: "His work was the starting point for our knowledge of the cochlea," he said.

It contains . . . so much interesting data that the attention of anatomists and physiologists everywhere has been drawn to it to an extraordinary degree. Unfortunately . . . Corti did not follow up his work and so fell short of the explanation of the meaning of some parts of the organ which he discovered. . . . No one knows better than myself the patience and devotion with which Corti went about his long task . . . and it would be difficult to find another monograph which is so significant, and so complete, as his.

The 150 reprints came, and with more honest pride than Corti would have liked to confess to, he distributed them among the anatomists and physiologists of Europe, including Todd and Bowman, of England, with whose opinions on the lamina spiralis he could but take exception in note 26 at the end of the work. This was the only time known when he publicly opposed the opinion of another man, and his statement is quoted here not only as a curiosum but because his observation proved to be the correct one:

Les anatomistes anglais ci-dessus nommés ont aussi donné une description assez exacte des dents de la première rangée, et du sillon spiral. Mais je ne puis partager leur opinion quant au rapport des dents avec le bord libre de la zone osseuse. Selon Todd et Bowman les dents se trouvent vers le sommet du limaçon plus en dedans du bord libre de la zone osseuse que dans le premier tour du limaçon même. Mes observations m'ont donné un résultat tout-à-fait opposé. Les mesures approximatives de la bandelette sillonnée données par les mêmes auteurs s'accordent parfaitement avec les miennes. Il paraît enfin que les terminations du nervus modioli dans la lame spirale décrites par Treviranus *(Zeitschrift f. Physiol. Bd. I.)* sous la forme de papilles ne sont autre chose que les dents de la première rangée. Telle est aussi l'opinion de Huschke.

Eckert in Freiburg, Valentin in Zurich, his old teacher Panizza, and the American anatomist Leidy, of Philadelphia, to name but a few, were in transports about the work.

Now one of the most famous anatomists of his time, a brilliant piece of work accomplished and more, a lifetime's task projected, what did Corti then do? Did he continue up the path he had marked out for himself? Obtain a chair in one of the great Italian universities? Lecture? Write? Bask in the light of his fame? To our surprise and chagrin, he did none of these things.

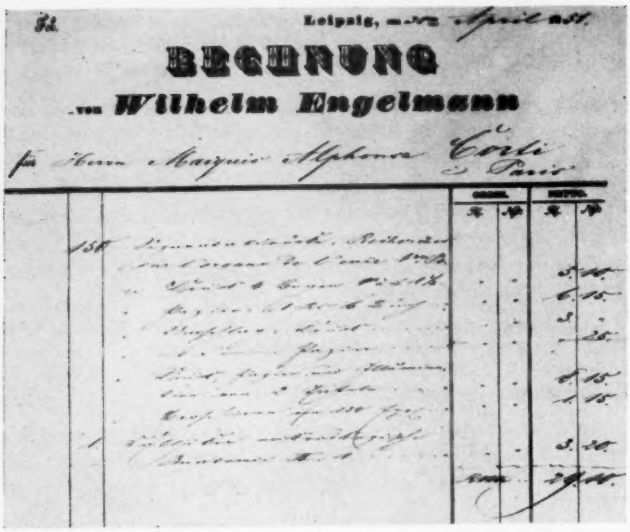


Fig. 14.—Publisher's statement to Alfonso Corti for 150 reprints.

CAESAREAE LEOPOLDINO-CAROLINAE ACADEMIAE
NATURAE CURIOSORUM

PRAESES

VIRO SERENISSIMO

MARCHIONI ALPHONSO CORTI
DE S. STEPHANO BELBO,

S. P. D.

Quod olim a primordiis suae cognitionis sibi elegit Academia nostra: NUNQUAM OTIOSUS, hoc ipsum et cunctis, in eandem recepti vel recipiendi, sedulo observarint et perpetuo observent, vehementer exoptat: neque illud quoque de his, quos noviter ad collegium suum invitat, aut qui generoso instituto ad societatem ferantur, aut qui a collegis commendati sunt, edocendi. Sunt enim luculentae rerum naturae, et medicae scientiae, et artis divinae, ut vulgari praestet aliquid, in quo industria se exerceat. Atque quum unius hominis, aut paucorum non sit, in tantum tamque amplissimum campum excurrere et cuncta in eo perscrutari, et inter mille rerum species, et verum discolor unum: adeque complurium bonarum mentium inclinatione, labore strenuo et consociatione opus est, - Quapropter non poterit non exoptius gratusque cernere nobis accessus Tuus, Vir excellentissime et experientissime, qui magis eruditio Tua, et in perscrutandis Naturae operibus admirandis studium, non nobis solum, sed inter orbi litterario cognita perspectaque iam existunt. Esto igitur, ex merito, cum quoque nostre! Inter *Academiae Caesareae Naturae Curiosorum* decus et augmentum, aucte virtute Tua et industria, et accipe, in signum amoris ordinis cui Te nunc adscribo, ex antiqua nostra consuetudine cognomen RUSCONI, quo collegam similemque Te hodie primum salutamus. Salve in consortio nostro! Salve, inquam, et effice, ut in posterum Tua, nunquam otiosa, suavi doctaque sodalitate inter nos quoque. Vale!

Bonnae in Universitate litterarum Vratislaviensi d. VI. JAN. a. MDCCCLIV.

CHRISTIANUS GODOFREDUS NEES ab ESENBECK,

Fig. 15.—Honorary degree, 1854.

His father died that season. His noble mother wept in the arms of her eldest son, to whom alone she seemed to turn in her deep sorrow. Her son! with whose ambitions she had sympathized, not understanding, and whose renown (only the hint of which was to come to her ears many years later) she could not grasp. He it was who would become the head of the family, rule, guide and protect it and its affairs as his father had done before him, a career in itself. Tenderly consoling his mother, Corti left for Gambarana and the funeral of that man with whom he had differed always, and whom, more unwillingly than not, he had had to defy in order to follow the dictates of his heart's ambitions.

Some said, afterwards, that his scientific career was only a "marking time" while he waited to inherit the title and position of the old Marchese, and that, if the latter had not died, he would have gone on "marking time"—in science, why not?—accomplishing the Lord knows what. They even said that if the old nobleman had died while Alfonso was still a boy he would probably never have gone into science at all! (They said this in light of his remaining days.) But then, people will talk. . . .

It took him three years—a "tedious and difficult probation," as his grandnephew has recently written—to settle the estate, in quite a jumble as it turned out, but he did it to the best of his ability.

Was it then that the fire died out in him? the burning curiosity of the anatomist to explore the details of the tissues in order to describe them? Something—what, we do not know—came like an enchanter and cast a spell upon him. His enthusiasm for his work vanished little by little, as a plant dies—not, as in the case of Rimbaud, like a candle flame blown out with one breath. Maybe it was the good hot beaming Italian sun that warmed his bones, chilled to taut pain in the dungeon-like dissecting rooms of the anatomical institutions of Europe. Maybe the beauty of the landscape suddenly smote his vision, netted and held him. Maybe ease and luxury after the Spartan days while he was a student lulled his aspirations to sleep. It was whispered that he found the exaltation of being sole answerer to the aristocratic title of Marchese di Corti di San Stefano Belbo a more potent and insidious influence than one might have supposed of a man of his selfless and objective turn of mind. Suffice it to say that there and then Alfonso Corti was at the omega of his career almost before the reprints of his classic third paper had all been read by their recipients. It may be protested that he continued his scientific investigations while settling the estate. Yes, but halfheartedly, going off on tangents and never again with the devotion once so conspicuous a part of him.

In the winter of 1851, Prof. Filippo de Filippi, director of the zoological museum of Turin, sent an urgent request: Would the Marchese di Corti do him the honor to participate in the examination of an elephant? It had died suddenly in the royal Stupinigi menagerie of asphyxiation after being accidentally exposed to carbon monoxide! "I accept your invitation with pleasure," Corti replied, and shut his door upon the chaos of high-piled family deeds and documents, not a few of which were two centuries old.

If he had written up that memorable examination otherwise than as a letter to Kölliker, it might have made a curiously interesting paper. It did, anyway, when Kölliker published it verbatim some time later. With this somewhat lengthy communication, he included drawings. He had measured the diameter of the red blood cells and found it 6.8 microns he said. They were spherical. The ciliated epithelium of the bronchial tree had ceased its motion as early as 10 hours after death in spite of the fact that it was cold enough . . . in the midst of December . . . so that one

would suppose it would have continued for days or even weeks. . . . He put down certain observations concerning the spleen, too, and how he discovered taste papilli on the dorsum of the tongue. In lavish detail he described the retina and the nerve fiber distribution within it. "I studied the specimen for many hours," he wrote, so like his old self that his former teacher saw no shadow of change in the zealous man who had been his pupil, "partly during the day, partly at night, using a kerosene lamp. I let the cells roll back and forth . . . added some acetic acid . . . became convinced that I was dealing with four . . . comparatively long fibers within the retina that interconnect the nerves. . . . Let us," he finished his letter, "let us

Fig. 16.—The scientist with mother, wife and children in the year 1859.

avoid . . . when we can . . . all hypotheses based on too few facts. Let us . . . accumulate facts."

Kölliker enjoyed and valued this letter. Two years later he had it published, writing Corti on May 23, 1853:

> After making a few grammatical changes I sent your letter on the elephant to the printer. The beautiful cells of the retina have interested me particularly and I wish I knew a method to bring them out as well as you did. . . . Think, in your fair country, occasionally of your truly devoted friend, Kölliker.

Professor Valentin, of Zurich, must have been shown the original of the letter or received a copy of it, and his enthusiasm knew no bounds. On May 5, 1852, he

wrote: "By the way! Your elephant! I would like to make a suggestion. Why don't you try to make a table of the microscopic dimensions and diameters of this colossal animal?" Five months later he again took up his pen. "I would be overjoyed," he pleaded, "to see a volume, encompassing a complete histology, written by you. . . . It would give you occasion to cover the whole field of the subject . . ."

A year after this, in 1853, they met in Turin, the last occasion in the life of Corti when he would be with an anatomist, for, when on his wedding tour in 1855 he visited the very centers where they worked in France, England and Germany, he

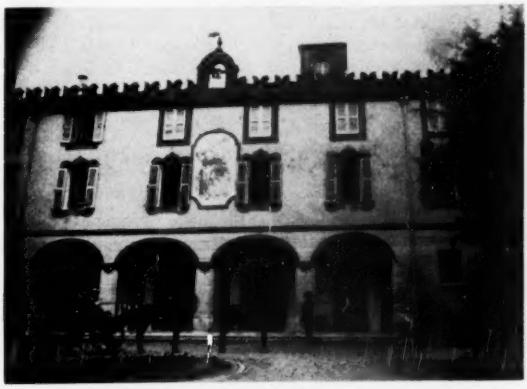


Fig. 17.—The palace in Mazzolino and the master out for a drive.

Fig. 18.—From anatomist to wine maker.

made no effort to meet or talk with any of the men in the field he once had held so dear.

During this meeting, reassailed at least temporarily by what had stirred him in former times, Corti perhaps mentioned another quest he had hopes to follow, for Valentin wrote him on Aug. 30, 1853: "Should I speak of your projected work on the medusa [jelly fish] and possibly prepare its reception in the transactions of the Leopoldina?" Two months later he wrote:

In case you wish to examine an echinoderm, I would suggest that you choose a synapta. The Mediterranean variety is small . . . generally transparent . . . both features advantageous to the anatomist. I do not know if Nice boasts many. . . . If not, I would suggest naked

molluscae—squids, cuttlefish, octopods—as alternatives. A third suggestion . . . to examine the sex forms of the hectocylar of the class of cephalopoda.

A proselyting man, Professor Valentin, with never a thought in his mind in all his long life but of work to do and the best means of doing it!

Corti, in the midst of his new life as Lord of the Manor, busy settling the large estate of his father, must have succumbed a little to the siren's call in these urgent letters and busied himself briefly with what the Swiss suggested, for Valentin wrote on Dec. 17, 1853, as if in answer to a fellow-consecrate:

I am overjoyed to learn that you are examining the plates of the electric organs of the torpedo fish. . . . My heart-felt thanks for your wonderful specimen [what these were we do not know] which gave me much pleasure. I will keep these treasures as if they were jewels, not only because of the scientific value, but as a token of your friendship!

Many, many requests came for contributions to scientific periodicals and text-books, and editors begged for his drawings. He worked a little, for the three years he was setting his patrimony in order, on marine fauna . . . putting down a few random observations, making a few drawings. But no longer with the old precision and passion! Never again with that. And when the tangled affairs were straightened out, he stopped even this "Sunday" work. Shall we not always wonder why?

Very plausibly it was his ill health—the ache in his bones put there by the cold of those clammy dissecting rooms, that no amount of sunlight could bake out. That, plausibly, and the fact that, like a cutthroat pinioning a man in a dark alley, the old hereditary disease of the born-to-the-purple attacked him—gout. Yet he was not disabled or confined to the armchair and litter for many years. He had the physical stamina necessary to manage two vast estates, to travel. . . .

He married. That may have made a difference. In 1855—four years after the publication of the "Recherches"—on September 24, in Cremasco, at her estate, he married a very beautiful and wealthy heiress, aged 20, Maria Anna Carlotta Bettinzoli, amid joyously elaborate festivities that lasted all of a week. The happy couple set out on a long journey. In England, they were the guests of his brother Luigi, then Italian ambassador in London, a proud post! (Did he seek out Gray? Todd? Bowman? Shake hands? Speak of old enthusiasms? No, he did not, but confined himself to social functions and renewing family ties.)

A year later, he bought an estate called Mazzolino, near the village of Casteggio, in Pavia, and took his wife and month old baby there to live. They had been residing at Cremasco and were still to oversee it from the distance of a few miles. The Marchese himself packed some of his things, those of especial value, to be sure that they were not forgotten. He opened a cupboard door and there, on a shelf, saw the bright gleam of a cherry-wood case, and reached out to touch it, remembering in a flash his young self, his far-reaching ambitions, the city of Pisa in the mists of autumn. Then he closed the cupboard door and turned away.

His wife opened it again when making a last minute check to see that everything was included. She came running out of the upstairs room and down the hall, to lean over the balustrade and call to her husband. "My dear, your microscope!"

"My what?"

"Can you imagine? You forgot it! Your microscope!"

Corti turned from the open door at which he stood watching the carters. "I will not need it at Mazzolino," he said, coming to the foot of the stairs and looking up at her. "I am leaving it behind."

When he died, at Mazzolino, in 1876, he had been a widower for 15 years, his young wife having fallen a victim to puerperal fever when their third child and only son was born. As he had foretold, in those two decades he did not need again the tool that had brought his fulfilment. The microscope stayed at Cremasco, where it may yet be, in the upstairs cupboard, in steep darkness, gathering dust.

His friend and physician, Carlo Vittorio Rovatti, recited his funeral oration, and it touched all hearers. Some of it went as follows:

In the flower of his years, surprisedly, there came a very serious gouty disease . . . compelling him to cut short at the height a brilliant career which was open to him. In a short

Fig. 19.—Chapel, cemetery of Corvino S. Quirino. The epitaph reads: "Hic jacet Alfonso, Marchese di Corti di San Stefano Belbo."

time, the disease deformed his hands and feet. In the latter years, he could not move about and he was unable to feed himself without aid. His limbs contracted from constant pain, he was confined to an armchair. At the last he became subject to the most profound piety. But he was a man of many resources, was the Marchese Alfonso Corti. Endowed by a strong will, he drew profit even from his misfortune. Seeing that the joys of city life were to be forbidden to him because of his infirmity, he withdrew to live in the country near Casteggio. There, with iron and gold, he created a farm on hills which yielded abundant fruit. To the peasant on the place which he occupied all the year round, he was a kind of saviour. His estate became a veritable training institution for agriculture and art. It seems to me . . . that I see him still, in the early morning, being borne on a litter over his vast estate, laying out plans for ditches and plantations, improving the grounds, instructing the peasants in the use of proper

language, not as a master, but as a teacher and father. I . . . hear him, as he sat in his armchair waving the tiny wand he always carried in his gout-deformed hands, in long conversation . . . full of enthusiasm, learning and good sense."

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LARYNGOCELE

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VENTRICULAR laryngocele, a term introduced by Virchow[1] in 1867, has reference to an outpouching or cystic dilatation of the saccus, or appendix, of the ventricle of Morgagni. The saccus, or appendix, arises from the roof of the anterior end of the ventricle and ordinarily extends superiorly, or cephalward, to the superior border of the thyroid cartilage. It is a persistent or constant anatomic entity, although in man it does vary greatly in size, ranging from that of a minor dimpling to a stalklike tubular structure.

According to Lindsay's[2] classification, a laryngocele has been found to develop in one of three ways:

The most common is said to be the internal laryngocele, a cystic dilatation appearing within the larynx, above the false cord, sometimes extending to the aryepiglottic fold or even to the base of the tongue. The cyst dilates on forced expiration and if large may produce obstruction. It deflates on quiet respiration, but may persist for some time. Hoarseness accompanies dilatation of the sac.

The second type is the superior external laryngocele, in which case the sac has perforated through the thyrohyoid membrane and appears as a swelling in the neck. The swelling enlarges on coughing, on physical exertion with the upper extremities, or straining at stool, and can be emptied by pressure, when the sound of escaping air, or air and fluid if the sac is infected, may be heard. Distention of the sac may be accompanied by local discomfort and headache, due to pressure on the large veins in the neck. If there is no accompanying internal laryngocele the voice will not be impaired. Infection and accumulation of fluid in the sac is likely, with resultant coughing and expectoration of pus when the sac is compressed. The external laryngocele can be satisfactorily dealt with by surgical removal.

The third type is a combined internal and external laryngocele such as reported by Shambaugh in 1915. In such cases the surgical treatment is complicated inasmuch as removal of the external part of the sac must be combined with an intralaryngeal operation to remove the internal laryngocele. Lewis recommended splitting the thyroid cartilage in front of the superior horn as the best means of exposing and removing the intralaryngeal part of the sac.

Etiologic factors requisite to the development of a laryngocele deny the necessity of preexisting pathologic conditions of the larynx. At the same time it is quite probable that tumorous masses,[3] granulomatous lesions, and inflammatory or edematous

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Read before the Philadelphia Laryngological Society, January, 1951.

1. Virchow, R.: Die krankhaften Geschwülste, Berlin, A. Hirschwald, 1867, Vol. 3, Pt. 1, p. 35; cited by Taylor, H. M.: Ann. Otol. Rhin. & Laryng. **53**:536 (Sept.) 1944.

2. Lindsay, J. R.: Laryngocele Ventricularis, Ann. Otol. Rhin. & Laryng. **49**:661 (Sept.) 1940.

3. (*a*) Jackson, C. L.: Laryngocele, Tr. Am. Laryng. Rhin. & Otol. Soc. **50**:492, 1946. (*b*) Schall, L. A.: Laryngocele—Associated with Cancer of the Larynx, Ann. Otol. Rhin. & Laryng. **53**:168 (March) 1944.

swellings may so affect the orifice of the sacculus as to produce the check valve mechanism necessary for the development of cystic dilatation. Repeatedly, one encounters in the literature [4] extensive discourses concerning atavism, occupational factors, congenital anomalies, and other conditions as contributory etiologic factors. In summation of these reports, their contents may be paraphrased that regardless of other etiologic factors the development of a laryngocele is basically dependent upon an abnormally increased intraglottic pressure.

Symptoms of a laryngocele are almost exclusively dependent upon its size, small cystic herniations being relatively asymptomatic. The internal laryngocele, as previously stated by Lindsay,[2] may dilate to the extent of causing hoarseness and dyspnea. This type of cyst, ordinarily expanding in the tissues beneath the ventricular band, may extend to the aryepiglottic fold or the base of the tongue. It dilates on forced expiration and ordinarily deflates during quiet respiration. If the orifice of the saccus is unobstructed, such dilatation may be of a transient nature; however, the check valve mechanism of such coexistent pathologic lesions, as previously mentioned, may effect persistent or permanent dilatation.

Extension of the cyst through the thyrohyoid membrane allows for the development of an external cystic tumor. Similarly, obstruction at the orifice of the saccus, or in the region of the thyrohyoid perforation, allows for continuing dilatation of this type of cyst. Symptoms of the superior external laryngocele depend upon the size of the cyst, together with the effects of pressure exerted by it on neighboring structures. With such a cyst, one may experience simple local discomfort, venous obstruction with resultant congestive type headache, or, if infection supervenes, pain and localized tenderness.

The diagnosis of laryngocele is most likely to be made if first one is aware of its existence. Corroborative measures, such as an evaluation of the symptoms related by the patient, the physical characteristics determined by examination of the external neck and by mirror laryngoscopy, and, of greatest significance, the objective demonstration of cystic masses by means of roentgenologic examination, should lead invariably to the proper diagnosis.

Laryngoceles sufficiently large to produce symptoms should be excised. The technique of operation depends somewhat upon the type of laryngocele present, the consensus [5] being that for the external superior type one makes the approach through a horizontal incision parallel to and beneath the ramus of the mandible, dissecting the sac down through the perforation in the thyroid membrane and amputating the stump close to the ventricle: the internal type is [6] best approached by way of a thyrotomy, preferably somewhat lateral to the midline. Again, dissection is carried out bluntly and amputation of the sac accomplished as close to the ventricle as possible.

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4. Taylor, H. M.: Ventricular Laryngocele, Ann. Otol. Rhin. & Laryng. **53**:536 (Sept.) 1944. Jackson.[3a]

5. (*a*) Allman, C. H., and Cordray, D. P.: Laryngocele, Ann. Otol. Rhin. & Laryng. **51**:586 (Sept.) 1942. (*b*) Lindsay.[2] (*c*) Jackson.[3a]

6. (*a*) New, G. B.: Treatment of Cysts of the Larynx, Arch. Otolaryng. **36**:687 (Nov.) 1942; (*b*) Congenital Cysts of the Tongue, the Floor of the Mouth, the Pharynx and the Larynx, ibid. **45**:145 (Feb.) 1947. (*c*) Fox, N., and Dinolt, R.: Cyst of the Larynx, ibid. **37**:552 (April) 1943.

It is an interesting commentary to note that although it is repeatedly stated that the internal type of laryngocele occurs most frequently, a review of the literature [7] from 1940 to 1949 shows that of a total of fourteen cases only four were of the internal variety (Table). Unusual cases include one of bilateral occurrence reported by Allman and Cordray [5a]; one with associated carcinoma of the larynx, by Schall,[3b] and one with a frank laryngopyocele by Lothrop.[8]

Cases of Laryngocele Reported in the Literature, 1940-1949

Author	Date	Number of Cases	Type of Cyst
Lindsay [2]	1940	1	External superior
New [6a]	1942	2	Internal
Allman and Cordray [5a]	1942	2	External superior (one bilateral)
Fox and Dinolt [6c]	1943	1	Internal
Lothrop [8]	1943	1	External superior (laryngopyocele)
Schall [3b]	1944	1	External superior (with cancer of the larynx)
Taylor [4]	1944	1	External superior
Campbell [7a]	1946	1	External superior
Jackson [3a]	1946	2	External superior
McLaurin [7b]	1947	1	External superior
New [6b]	1947	1	Internal

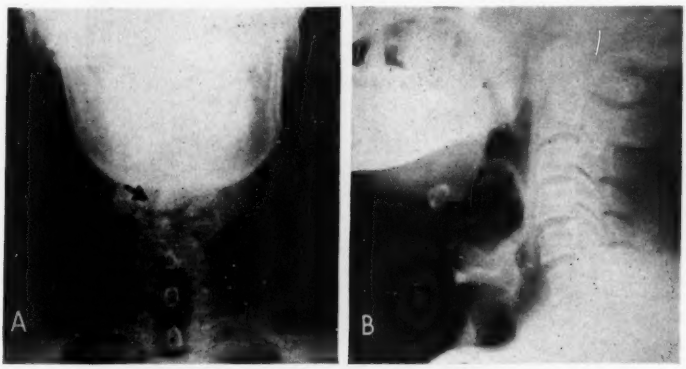

Fig. 1.—Posteroanterior (*A*) and lateral (*B*) roentgenograms of the neck, showing the presence of a large air cyst of the larynx.

Lewis [9] first recommended the splitting of the thyroid cartilage in front of its superior horn as the best means of approach for excision of the stalk of the external laryngocele. This approach was modified by New [6a, b] in his description of lateral thyrotomy for removal of the internal variety of laryngocele. It is stressed by Jackson [3a] that before proceeding with excisional surgery one should make every

7. (*a*) Campbell, M. D.: Laryngocele, Arch. Otolaryng. **44**:219 (Aug.) 1946. (*b*) McLaurin, J. W.: Laryngocele: Report of a Case, Laryngoscope **57**:616 (Sept.) 1947.

8. Lothrop, O. A.: Laryngocele: Report of a Case, New England J. Med. **229**:681 (Oct. 28) 1943.

9. Lewis, cited by Allman and Cordray.[5a]

Fig. 2.—Cystic mass excised.

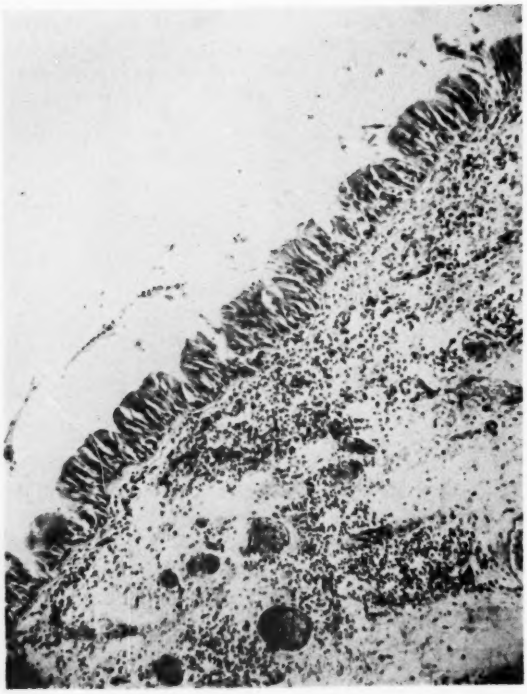

Fig. 3.—Pseudo-columnar-epithelial lining of the cystic mass.

effort to rule out related diseases as possible causes of obstruction. He cites a case of laryngocele associated with laryngeal papilloma in which removal of the papilloma allowed for deflation of that cyst.

REPORT OF A CASE

J. M., a white man, aged 45, was referred in April 1950, because of severe dyspnea and associated hoarseness. Questioning elicited that his hoarseness had been progressive over the last six months and that the dyspnea was first noted three weeks ago, coincident with the presence of an upper respiratory tract infection. In this three week period both the hoarseness and the dyspnea had become so markedly aggravated that at present he was almost aphonic and presented the typical picture of severe acute laryngeal dyspnea. His temperature was 103 F.

Examination of the neck determined the presence of marked interference with mobility of the larynx but no signs of tenderness. There were no evidences of tumor or of palpable cervical lymph nodes. Mirror laryngoscopy revealed that the left ventricular band was markedly full, displaced to the right across the midline, completely obstructing a view of the glottis. Because of the apparent extreme condition of the patient, he was immediately hospitalized and placed in oxygen. This partially alleviated his dyspnea, but not sufficiently to allow him to sleep or to rest adequately. Antibiotic therapy was instituted. A tracheotomy was then performed with the area under local anesthesia.

Posteroanterior and lateral roentgenograms of the neck (Fig. 1) showed a sharply defined curvilinear shadow located in the left portion of the thyroid cartilage region extending slightly to the right of the midline but located for the most part on the left side. These findings supported the diagnosis of laryngeal cyst made clinically.

With the patient under endotracheal nitrous oxide-oxygen-ether anesthesia, a midline vertical incision was made exposing the larynx. The thyroid cartilage was split just to the left of the midline. This allowed for the exposure of a large cystic mass apparently contained beneath the mucosa of a greatly distended left false cord. Dissection was completed and the stalk followed to the region of the ventricle, where it was amputated. The larynx was closed without drains. The wound healed by first intention. The cannula was removed on the third day, and the patient was discharged from the hospital on the seventh day. At the time of writing, eight months later, there is no evidence of recurrence of the cyst and the patient has regained a relatively normal voice.

Sections of the cystic mass were studied by the pathologist. He reported that the mass had a lining of respiratory type epithelium. The wall was densely infiltrated by chronic inflammatory cells. There was no evidence of malignancy in the sections examined consistent with laryngocele.

SUMMARY

Laryngocele in man is briefly reviewed and a case of internal laryngocele reported. Surgical excision was carried out, apparently successfully, for after a period of eight months there is no evidence of recurrence and the appearances of the larynx are well within normal limits.

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LARYNGEAL OBSTRUCTION DUE TO ANTIBIOTIC THERAPY

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LARYNGEAL obstruction, whether due to foreign body, to inflammation, or to allergic reactions, alarms the patient and the laryngologist. It is a problem of serious import, necessitating constant vigil and prompt remedial action. Treatment may be medical or surgical, or at times both. It is the purpose of this paper to deal with laryngeal obstruction due to penicillin. The newer antibiotics are not discussed here because they have been in use only a short time and few cases of sensitization have developed.

Peck and Siegal [1] at Mount Sinai Hospital, New York, have studied allergic reactions to penicillin and have divided them into four groups:

Group 1: Reactions similar to those seen in other cases of drug sensitization and often characteristic of serum sickness. Closely allied to this group are the various toxic erythemas and the severe local reactions after the administrations of penicillin in beeswax and peanut oil.

Group 2: Reactions following local applications of the drug, falling into the category of allergic contact dermatitis.

Group 3: Erythematovesicular eruptions which often are initiated on . . . hands, feet and groin, at the sites of previous fungous infection. This type of reaction can be explained by the fact that the fungi commonly responsible for dermatomycosis in these areas are capable of producing penicillin.

Group 4: Febrile reactions, usually unaccompanied by cutaneous manifestations, following aerosol inhalation or bronchial instillation of penicillin. This form of reaction may ultimately be classified with group 1.

Barker [2] believes that in time the other antibiotics will have sensitized individuals and will produce thereby allergic reactions similar to those seen in the use of penicillin. Penicillin has been too convenient a drug, since it is specific for most organisms and since there is no need to check the blood and urine. The value of penicillin to the physician is threatened because sensitivity to the drug may result from its use for trivial symptoms. When penicillin is used in this way, treatment may do more harm than the underlying disease.

In laryngeal obstruction due to allergic reaction the pathology is essentially an angioneurotic edema involving the tongue, pharynx, hypopharynx, epiglottis, and larynx. There is often marked erythema. The epiglottis plays an important part by reason of its anatomy. On its anterior surface the mucous membrane is not adherent as it is on the posterior surface, and edema brings about a folding back-

Read before the New York Academy of Medicine, Section on Otolaryngology, New York, Nov. 15, 1950.

1. Peck, S., and Siegal, S.: Successful Desensitization in Penicillin Sensitivity, J. A. M. A. **134**:1546-1547 (Aug. 30) 1947.

2. Barker, L. P.: Personal communication to the author.

ward toward the glottic chink with encroachment on the airway, which has already been narrowed by swelling of the larynx. Hoarseness is frequent and when croupy in character points to involvement of the subglottic tissues. Decreased oxygen intake brings about an increase in carbon dioxide-combining power, a stimulation of the respiratory center, and subsequent fatigue of the patient by reason of increased respiratory rate.

The symptoms of air hunger may be acute or may be insidious and cumulative. A patient with acute laryngeal obstruction presents a picture of massive edema which calls for immediate restoration of the airway by intubation or tracheotomy, since other types of medication will not effect a cure soon enough. Laryngeal obstruction of the insidious and cumulative pattern calls for frequent and vigilant observations, since the longer the period of oxygen want the more complex the symptoms become. The element of fatigue seen in this type of obstruction may counteract the strenuous efforts which the patient should be making to obtain sufficient oxygen. It is difficult to realize the true picture of prolonged hypoxia of varying degrees beyond the physical findings on local examination. Nerve and brain tissue are especially vulnerable to oxygen deficiency, and mental symptoms present themselves early. It must be borne in mind that cardiovascular and metabolic disturbances further complicate an already complex situation. The sequence of symptoms, as mentioned by Galloway,[3] progresses from early signs of restlessness through depression, confusion, disorientation, irrationality, unresponsiveness, lethargy, and finally coma. Sedation for alleviation of restlessness, though necessary, may mask the true picture of hypoxia, much as anesthetic ear drops relieve the pain of a child with an acute ear infection but do not change the pathology.

The principal physiological actions of the larynx are phonation and closure of the glottis by sphincteric action of the ventricular band. Interference with normal physiology of the airway brings about a decrease in oxygen intake. McReynolds[4] stated,

> The laryngologist should be more observant of the general condition of the patient as regards the cardiovascular system, respiratory physiology and mental status rather than depending entirely upon the classical signs of suprasternal, epigastric and intercostal indrawing on inspiration in deciding on the optimum time or the imminent need for tracheotomy.

Impairment of the airway will bring about varying degrees of hypoxia and after a period may result rapidly in shock and asphyxia. Time runs out fast. Frequent laryngeal examination is mandatory in order to evaluate a patient's progress.

The treatment of this type of laryngeal obstruction may be medical or surgical or at times both, as I have mentioned. Choice of treatment is governed by the degree of impairment of the airway and the presenting symptoms of hypoxia. If treatment is deferred until some degree of cyanosis is present, the laryngologist will realize suddenly that it is too late to do much except by heroic measures.

Medical treatment consists in securing an oxygen balance, obtaining sedation for the patient, and instituting antihistaminic therapy. Oxygen balance is restored by giving the patient oxygen either by intranasal catheters or by mask. A tent

3. Galloway, T. G.: The Danger of Unrecognized Anoxia in Laryngology, Otol. Rhin. & Laryng. **55**:508-519 (Sept.) 1946.

4. McReynolds, G. S.: Physiology of the Larynx, Tr. Am. Laryng. Rhin. & Otol. Soc. pp. 201-213, 1948.

should not be used, inasmuch as there is leakage and it takes about 45 min. to secure the necessary oxygen concentration. Sedation of the patient by morphine should not be started until the oxygen balance has been restored. Sedation is important, since it will remove the patient's apprehension, lower the metabolic rate, and thus decrease the oxygen need. The early use of an antihistaminic drug is imperative. The edema of the hypopharynx may make swallowing difficult and thus preclude use of the drug by the oral route. Too, the effect will be slower than by the intravenous method. It is more beneficial to the patient if oral administration of tripelennamine (pyribenzabine®) is used to supplement the dosage given by vein. The dosage by mouth should be about 200 mg. a day in 50-mg. units four times a day.

Intravenous injection of diphenhydramine (benadryl®) hydrochloride may be given directly or with an infusion of distilled water and dextrose, but never with saline solution. Dextrose is used in order to minimize any loss of glycogen due to hypoxia. An infusion is necessary when it has been impossible for the patient to have a fluid intake of 3,000 cc. a day. There need be no hesitancy in giving an infusion, since there is no danger of increasing localized edema when it is due to allergy.

Diphenhydramine solution for intravenous injection contains 100 mg. to each cc. Four to 6 cc. may be given at once and followed each day by a 1-cc. dose until the edema has subsided. This dosage may be increased at the beginning should the edema fail to respond to the drug.

After the patient has received the medical treatment of sedation, oxygen, and antihistamine agents, a trial should be made without administering oxygen. Should the hypoxia recur, it is evident that the obstruction is progressive, and intubation or tracheotomy must be done at once lest irreparable damage be done to nerve and brain tissue. Intubation is less desirable because the tube acts as a foreign body, irritating tissues already edematous. Medical treatment should not be discontinued until oxygen balance has been restored and the edema of the larynx has subsided. Epinephrine is not the drug of choice because it is seldom effective and because it tends to increase the metabolic rate. We have had no experience in the use of ACTH for this type of angioneurotic edema.

In connection with this clinical entity I am reporting the following four cases from the Department of Otolaryngology, St. Luke's Hospital, New York.

REPORT OF CASES

Case 1.—S. M., a white woman, 52 yr. old, gave a history of having thought a fishbone was stuck in her throat. Her physician gave her a penicillin injection. The following day she complained of dysphagia and soreness of the cervical nodes. She could swallow fluids only with difficulty and had slight difficulty in breathing. When she was admitted to the hospital, the patient complained of an extreme sore throat, malaise, and very husky voice. Laryngeal examination showed moderate edema of the epiglottis and arytenoid areas. The edema slowly increased. Treatment consisted of elixir of tripelennamine (pyribenzamine®) citrate and intravenous injection of diphenhydramine. Shortly after the injection of diphenhydramine was given, examinations showed blanching of the larynx and epiglottis. Edema continued to disappear, symptoms decreased, and the patient went home on the fifth day.

Case 2.—P. A., a 38-yr.-old white man, gave a history of having had a sore throat for four days. A druggist gave him penicillin tablets. The next day the patient was brought to the hospital with respiratory difficulty, clutching at his throat. The oral cavity, hypopharynx, and larynx showed marked allergic reaction. The patient was apprehensive, and, since the airway

was already markedly decreased, a tracheotomy was done. He was treated medically with tripelennamine, 50 mg. three times a day. Recovery was uneventful, and the patient was discharged after two weeks.

CASE 3.—M. D., a 30-yr.-old white man, was admitted from the clinic with massive laryngeal edema. He gave a history of having had an intramuscular injection of penicillin the day before. The airway was markedly encroached upon by edema, and tracheotomy was done soon after admission. A roentgenogram showed mottling of the lower lobe of the right lung, and the patient was given a sulfonamide for bronchitis. The edema did not decrease in sp'te of intravenous injection of diphenhydramine but subsided when use of the sulfonamide was stopped. The patient was hospitalized for a total of two and a half weeks.

CASE 4.—J. C., a 53-yr.-old white physician, had had two injections of penicillin in oil and wax. Urticaria and edema of the trunk and extremities developed. This subsided after antihistaminic drugs were administered orally, and the patient was released from the hospital. Four days later, however, the allergic reaction came on again with marked laryngeal edema. At this time diphenhydramine was given intravenously, and the angioneurotic edema subsided. Hospitalization totaled seven and six days respectively. It is difficult to say whether or not the allergic reaction was due to the vehicle or to the penicillin. However, the patient, a physician, has remarked that he will never have penicillin again.

All the patients had a febrile reaction lasting from two to four days. It is interesting to note that three of the patients received penicillin by injection and one by the oral route. Could it be that the oropharynx has been sensitized through many years of ingestion of molds and thus has developed the basis for allergic angioneurotic edema? This seems quite plausible and would fit the three cases in which gluteal injections were given.

SUMMARY

1. Allergic reaction from antibiotics is essentially an angioneurotic edema, which may have very serious manifestations.

2. Penicillin sensitization is due either to previous penicillin therapy, or to previous infection of fungus, or to repeated ingestion of molds.

3. Antibiotics should not be used for the sake of convenience, nor should they be used indiscriminately while diagnostic procedures are being done.

4. Treatment must be directed toward alleviating restlessness and hypoxia and toward decreasing angioneurotic edema. Temporizing is not without danger.

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FUNCTIONAL DEAFNESS

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FUNCTIONAL hearing loss is a term applied to all nonorganic deafness. It is a condition in which the patient does not fully utilize his residual hearing as determined by numerous available tests for detecting organic loss in auditory acuity. Psychogenic deafness, another synonym for functional hearing loss, has been recognized by otologists for many years but usually only in gross forms such as hysterical deafness with amblyopia and anesthesia. Recently, however, less obvious forms are being recognized, and the incidence of psychogenic components in deafness is found to be more prevalent. The only statistics regarding the incidence of functional deafness are from armed forces hearing centers, where from 10 to 25% of all hard of hearing patients were reported to have significant functional hearing involvement.[1] Civilian incidence of functional deafness is probably below the percentages found in the reports from the military services. It is significant that about 70% of the cases of proved functional deafness in the Army presumably had little relationship to combat service.[1] The disruption of family life, discipline, and so forth, have definite emotional effects, even in noncombat service. We must bear in mind, however, that frustration, emotional conflict, and insecurity, among the commonest etiological factors in producing functional symptoms, are not unique to military life and are also quite prevalent in our complex civilian society.

From the standpoint of the otologist, functional deafness may be considered under the following aspects.

PSYCHOLOGICAL

The manner in which patients react to a defect such as deafness may vary considerably. Persons with deafness of recent onset often try to minimize or hide their defect. In order to maintain a conversation, they make strenuous listening efforts and tend to fill in hearing gaps by guessing or by acting with pleasant affability. This dissembling sometimes leads to embarrassing situations and at best is very fatiguing, leading to nervousness and instability. Another type of reaction, more frequently seen in cases of long-standing hearing loss, is a withdrawal of either interest or attention or both. Withdrawal of interest is exemplified in avoidance of social contacts and preoccupation. Withholding of attention may be involuntary, as in the case of a person who fails to hear when spoken to while engrossed in reading, or voluntary, as the deliberate shutting out from consciousness of a dull speaker.

1. Martin, N.: Psychogenic Deafness, Ann. Otolaryng. **55**:81-89 (March) 1946.

Unlike the blind and crippled, the deaf have no outward signs of disability, and strangers are apt to confuse imperfect hearing with imperfect understanding. The patient feels resentful at this attitude and isolated from full social contacts. As a result, he tends toward moods of frustration, insecurity, suspicion, and sometimes aggression. These factors should be recognized by the physician who deals with hardness of hearing as a normal psychological reaction. In order to label a reaction neurotic or psychiatric, it must be either an emotional overreaction or an emotional underreaction, according to accepted standards.

Such factors as habitual inattention or lack of interest may cause discrepancies in test situations. Other factors, such as phonemic regression and the lack of appreciation of threshold sounds, may likewise produce inconsistencies. The last-mentioned is particularly noted in conductive loss as improvement in acuity with successive audiograms until the plateau of best hearing is obtained.

MALINGERING

Malingering is the deliberate fabrication of symptoms in whose reality the patient does not believe. A malingerer characteristically maintains his capacity for play and abandons his symptoms when not under observation by those whom he wants to impress by a disability. The neurotic, on the other hand, is personally convinced of the reality of his symptoms, and they interfere with his pleasures as well as his work.

We are all guilty of malingering in a small way when, for example, we feign a headache to escape a dull social engagement. The normal person usually uses a short-lived symptom, such as a headache, as an escape mechanism and if caught shows a typical shame reaction. The person who undertakes to feign such a symptom as deafness for a protracted period is probably abnormal and should be considered to possess an inadequate personality structure. This type of person characteristically seeks an easy way of accomplishing his ends and has no qualms about adopting socially reprehensible methods to attain them. He is legally responsible but often must be kept in line socially by coercion.

It is possible that a normal person will feign deafness on the occasion of a single examination, for example, to escape military service or to obtain compensation for an injury. These persons, however, will not carry out the elaborate simulation sometimes shown by the malingerer with a personality disorder.

PSYCHONEUROSIS

Anxiety, the product of emotional conflict, is basic to all neurotic manifestations. Anxiety is to the emotions what pain is in the physical realm. Normal anxiety has an adequate cause which is recognized as such and recedes when the cause is removed or with the passage of time. Neurotic anxiety is excessive and unwarranted by usual standards. The true cause is seldom recognized by the patient, and it persists beyond any recognizable need.

While for practical purposes it is necessary only to recognize the presence of a psychoneurosis without further categorizing, some effort at classification is useful to the otologist, if for no other reason than to point out various manifestations of psychoneurosis. To the psychiatrist, the presenting symptom is less important

than the general behavior pattern of the person. The otologist, on the other hand, not only can but should be able to make or exclude a psychiatric diagnosis so far as symptoms are referred to his sphere of interest.

Anxiety Neurosis or Reaction.—If there is a partial transfer of anxiety to a somatic organ, such as the ear, there may be partial deafness, but a great many emotional symptoms, such as insomnia, persist. Tinnitus is characteristic when the ear is involved, and such patients often claim that the sounds are unbearable. Hearing acuity is usually variable, depending upon the emotional state of the person tested at the time of testing. These patients may appear to be overly anxious or concerned over their auditory symptoms, when in reality some or all of the deafness and tinnitus is caused by anxiety, the cause of which lies elsewhere.

A type of this reaction is the neurasthenic reaction. The essence of this type of reaction is selective pathological fatigue. Such a patient may hear well at first but rapidly loses hearing acuity, even while being tested. Another manifestation may be marked difference in ability to hear one type of sound, e. g., pure tones, as compared with another, e. g., speech.

Conversion Hysteria or Dissociative Reaction.—When all or nearly all the anxiety is transferred or fixed to one or more somatic organs, we have hysteria or a conversion state. Here, the essence is inhibition of function. There is usually an indifference of the patient to his symptoms, despite their apparent severity, and he often delays seeking medical advice until urged to do so by associates. He underreacts emotionally, is unconcerned, and appears calm and collected. This is because he has partially solved an emotional conflict by assuming a somatic symptom. This solution is generally incomplete, and careful scrutiny will show residual emotional or autonomic disorders. Ear symptoms in this type of case are characterized by a uniform flat loss in all frequencies, suggestive of a well-marked conduction deafness. However, in all these patients the bone conduction is very much reduced and often absent. In a patient with unilateral deafness there may be complete absence of bone conduction on the side of the bad ear, despite the fact that the good ear has normal acuity. Such a patient may even disclaim hearing shouts directed at the bad ear, in spite of good hearing in the other ear. This makes the Stenger test uniformly successful in cases of unilateral deafness. The onset of deafness is often sudden and ordinarily follows some emotional disturbance. There may be associated symptoms, such as hemianesthesia or paresis, but such gross symptoms are much less frequently seen than formerly. Tinnitus and vertigo are usually absent.

Hypochondria.—This state may be defined as a marked preoccupation with a single symptom, such as deafness. There may be minimal or marked organic deafness, but the disability is always out of proportion to the degree of organic deafness. Because of his anxiety, the patient adapts his life to his symptoms rather than adjusting to life. He forces his symptoms upon his friends so repeatedly that every time his name is mentioned they immediately think of his symptoms.

A term frequently encountered in the literature is functional overlay. This covers all forms of functional deafness superimposed on organic deafness. It is the responsibility of the otologist to determine the presence and degree of both types of deafness in any given patient.

A critical appraisal of routine tests usually leads to the diagnosis of functional deafness. In an organic lesion, all tests not only must be capable of repetition with

only minor variations but also must correlate with one another.[2] It is a mistake to attribute well-marked discrepancies to individual variations. Various authors have suggested findings that should alert the otologist to the possible presence of a functional hearing loss. The following have been found useful:

1. A medical history that experience indicates could not possibly explain the patient's condition, such as the sudden onset of profound hearing loss following the instillation of drops into the ears. Care must be taken to exclude all possible causes and not simply to disprove the patient's explanation.

2. No improvement in speech reception in a patient with marked hearing loss with the use of a hearing aid and with use of spondee words or sentences unless the patient is totally deaf.

3. Too great an improvement with a hearing aid, especially when the patient has set the controls at minimal amplification. If hearing is suddenly greatly improved by a simple procedure, such as drum massage, the power of suggestion should probably receive the credit rather than the mechanical procedure.

4. Marked fluctuation in hearing acuity as determined by any single test. The importance of repeated tests cannot be overemphasized. It is especially indicated to establish basic hearing on which to evaluate results of any treatment to be undertaken.

5. Inconsistency in the results of two or more tests. This inconsistency may be better hearing for speech than for pure tone or vice versa. In malingering inconsistencies are usually inconstant, whereas in neurotic deafness they are characteristically constant and constantly inconsistent.[2]

6. Psychiatric manifestations, such as emotional symptoms or their vegetative or somatic signs. No single test has proved sufficient for a diagnosis of functional deafness. A complete evaluation of the patient and all the findings must be done.

7. Reflex reactions produced by sound. In the presence of alleged complete deafness, the presence of cochleopalpebral reflexes indicates either malingering or hysteria. The psychogalvanic skin resistance test is also useful in establishing true hearing when subjective responses are unreliable.

Once the diagnosis of functional hearing loss is established, the therapeutic approach must be considered. Psychological defects can be benefited by aural rehabilitation in all its phases. With the transient malingerer, a "Dutch Uncle" talk will usually dispel symptoms. The malingerer with a personality disorder will not be disposed of so easily. It is probably best simply to record the best hearing obtainable by various and repeated tests together with an opinion that the hearing is at least as good as that on the best test and possibly better. Personal altercation should be avoided. The otologist must decide for himself whether psychiatric involvement in cases of functional deafness is not too profound and complex for him to handle personally. Some factors in determining that the otologist may assume the responsibility for psychotherapy are (1) a young patient; (2) short duration of the functional disturbance, with history of antecedent stability; (3) history of an important emotional crisis now past, and (4) ability of the physician to obtain the confidence of the patient.

If the patient shows evidence of chronic or repeated emotional upsets, the otologist will find it much more satisfactory to refer him to a psychiatrist. Often, therapy may require the combined efforts of the otologist, psychiatrist, and audiologist. The essence of psychotherapy is, first, that the otologist be a sympathetic

2. Harbert, F.: Functional and Simulated Deafness, U. S. Nav. M. Bull. **41**:458-471 (March), 717-728 (May) 1943.

listener. He should let the patient unburden himself and speak only to keep the patient talking. The second aspect of psychotherapy is interpretation of the causal mechanisms in emotional illness with somatic manifestations. It is important that he avoid the role of judge in thought as well as in action. The patient will sense any hostility or lack of sympathy and understanding on the part of the interviewing physician.

SUMMARY

Functional deafness is considered from the standpoint of the otologist under the following headings:

1. Psychological
2. Malingering
   (*a*) Transient
   (*b*) Personality disorder
3. Psychoneurotic
   (*a*) Anxiety neurosis
      (*1*) Neurasthenia
   (*b*) Conversion Hysteria
   (*c*) Hypochondria

Criteria suggestive of the presence of a functional element are enumerated, and a therapeutic approach is briefly outlined.

TRANSTYMPANIC INJECTION OF ANESTHETICS FOR THE TREATMENT OF MÉNIÈRE'S SYNDROME

MATTHEW S. ERSNER, M.D.
E. A. SPIEGEL, M.D.
AND
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THERE seems to be some controversy in the literature concerning the precise nomenclature for the attacks of labyrinthine vertigo originally described by Ménière and often combined with tinnitus and impairment of hearing.

Older authors applied the term Ménière's disease to this symptom complex, while more recent workers prefer to refer to it as Ménière's syndrome. Certainly, we all agree that the most prominent symptom in Ménière's syndrome is the vertigo which may originate in the inner ear, in the vestibular nerve, in the cerebellopontile angle, or in the central nervous system. A functional factor, psychosomatic mechanisms, or malingering may also play an important role.[1]

The etiological basis of Ménière's symptom complex is not definitely known, and many causes are ascribed, such as the following: vascular disturbances (abnormal permeability of the capillaries, disturbances of lymph circulation leading to hydrops of the labyrinth, vascular spasms), allergic conditions with increased sensitivity to histamine, and abnormalities of the water or salt metabolism inducing edema of the labyrinth. Infection, geratric changes, endocrine dysfunction, and vitamin deficiencies [2] may be additional factors. However, the role of vitamin deficiencies should not be overestimated, since many of the prisoners of war who were underfed and undernourished and displayed a complete deficiency in vitamins did not present any of the symptoms of the Ménière syndrome.

Of all aural symptoms, vertigo is one of the most disturbing. This symptom causes the patient to be unable to walk a straight line and to weave from side to side. In fact, many must of necessity remain in bed. There is a sensation of nausea and vomiting, and the vertigo is aggravated on moving of the head or opening of the eyes. In addition, it is often associated with pallor, cold sweats, and attacks of

Read before the meeting of the Section of Otolaryngology of the College of Physicians of Philadelphia, Philadelphia, Dec. 20, 1950.

From the Department of Otorhinology and the Department of Experimental Neurology, Temple University Hospital and School of Medicine.

1. Rachlis, B.: Ménière's Syndrome: Proposed Classification and Differential Diagnosis, Arch. Otolaryng. **52**:373 (Sept.) 1950.

2. Atkinson, M.: Ménière's Syndrome: Observations on Vitamin Deficiency as the Causative Factor: III. The General Disturbance, Arch. Otolaryng. **51**:149 (Feb.) 1950.

feeble pulse. Nystagmus may be mild or of the third-degree type associated with vertigo. Tinnitus aurium usually remains localized in the ear. Unfortunately, most patients have perceptive deafness with a profound hearing loss. Deafness in Ménière's syndrome is invariably featured by a greater loss in speech intelligibility than in pure-tone acuity.

Most of the patients that we had selected for this study showed an involvement of the cochlear and vestibular portion of the labyrinth. Those who had severe tinnitus concomitant with the vertigo had no vascular bruit, and the tinnitus did not change on pressure over the carotid artery. This partially eliminated vascular tinnitus. The tinnitus was mostly in the high frequencies, beginning with 4096 or 8192 d. v. per second, and of high intensity. Several patients had tinnitus in three frequencies—2048, 4096, and 8192 d. v.

Not infrequently one may find a tendency toward grouping various types of vertigo with the Ménière symptom complex. It must be emphasized, therefore, that the diagnosis of Ménière's syndrome should be made only after careful analysis of the attacks and thorough otological and neurological examination.

Various methods of treatment have been employed in the alleviation of this symptom complex. Some investigators prefer the surgical approach, while others employ the more conservative or medical management of this syndrome. For example, in the surgical treatment, Dandy advocated the section of the eighth nerve, while Day [3] instituted the electrocoagulation of the labyrinth. On the other hand, Lempert [4] is of the opinion that surgical approach on the vestibular apparatus is inadequate. He introduces a surgical procedure involving adequate exposure of the stapes, which when pulled out decompresses the apparatus. This procedure is followed by opening the round window, thereby decompressing the cochlea. There are those who follow the more conservative approach. For example, Furstenberg feels that the sodium salts should be controlled, while Mygind and Dederling believe that there should be a limitation of fluid intake. Others are of the opinion that it is necessary to supplement the deficiency of nicotinic acid, vitamin B complex, riboflavin, etc. Use of various vasodilator drugs has been found to be effective in giving symptomatic relief. These include magnesium sulfate administered intravenously and histamine, which can be given intravenously or subcutaneously.

Our approach, which we shall describe later in greater detail, consists of transtympanic injection of 2% cocaine solution or 2% tetracaine (pontocaine®) hydrochloride solution or 35 to 50% ethyl alcohol into the tympanic cavity.

In 1944 one of us (E. A. S.) invited another (M. S. E.) to participate in the problem of transtympanic therapy for labyrinthine symptoms. Spiegel [5] observed that in cats paralysis of the labyrinth can be obtained by electroendosmosis of cocaine solutions from the external auditory meatus. In cats, and sometimes in dogs, such an effect can be produced by the injection of local anesthetics into the tympanic cavity. The effect can be prolonged by combination of the local anesthetic with vasoconstrictors.

3. Day, K. M., and Lindsay, J. R.: Hydrops of the Labyrinth: Case Report: Coagulation Operation, Clinical Course and Histopathology, Laryngoscope **59**:213 (March) 1949.

4. Lempert, J.: Tympanosympathectomy: A Surgical Technic for the Relief of Tinnitus Aurium, Arch. Otolaryng. **43**:199 (March) 1946.

5. Spiegel, E. A.: Production of Labrinthine Paralysis by Application of Local Anesthetics to External and Middle Ear, Proc. Soc. Exper. Biol. & Med. **56**:137 (June) 1944.

In view of the fact that Spiegel was able to eliminate the impulses from the labyrinth by this method, we felt that the use of transtympanic injections for the treatment of abnormal labyrinthine irritation, in the form of vertigo and tinnitus, warranted investigation and consideration. Its use on patients presenting this symptom complex was, therefore, proposed.

In attacking the treatment of Ménière's syndrome, we propose the medical management as the first method of approach, as we do not favor surgical intervention unless medical treatment has completely failed. We feel that few patients require radical surgical measures. The disadvantage of medical treatment, however, is that it is time-consuming and requires careful supervision. Transtympanic therapy is a simple procedure but cannot be carried out as an office routine because of the patient's reaction.

SELECTION OF PATIENTS FOR TRANSTYMPANIC TREATMENT

It is of utmost importance to remember that if good results are to be obtained the cases for injection must be selective; the following points should be noted:

1. A careful history of the case must be taken.

TABLE 1.—*Age and Sex Distribution of Patients with Ménière's Syndrome*

Number of Patients	Age, Yr.	Sex
2	27 and 28	F
4	31, 31, 36, and 38	F
9	3 under 45	F
	2 were 47	M
	4 were 49	F
14	50-59	F
7	60-69	F
1	71	F

2. A history of attacks of labyrinthine vertigo accompanied with tinnitus and subtotal deafness suggests a suitable case for transtympanic therapy.

3. There must be no history of cardiac disease.

4. No gross signs of vascular changes should be present.

5. Aural pathological changes must be absent.

6. No intracranial lesion should be present.

7. The tympanic membrane must not show active pathological involvement.

8. The Eustachian tubes must be patent.

9. There must be no history of aero-otitis media or barotrauma.

10. An upper respiratory infection must not precede vertigo.

The following is a typical presentation of a case:

1. The vestibular and cochlear portion of the labyrinth are involved, with vertigo accompanied with vasomotor disturbances, nausea and vomiting, and diminution or loss of auditory sensitivity.

2. At first, there is a loss in the low frequencies which is then followed by perceptive deafness, or the cochlear dysfunction may begin with nerve-deafness.

3. The patient feels better on lying on the sound or unaffected side.

4. There is no evidence of pathological involvement of the tympanum.

5. The eardrum membranes are normal.

6. The Eustachian tubes are patent.

7. Tinnitus does not subside on pressure over the carotid arteries.

8. There is evidence of progressive deafness with each attack.

Ménière's syndrome is essentially a disease of the middle-aged, although there is no definite age limit. However, of the 37 patients whom we selected, 15 were under 50 yr. of age. All 37 patients presented unilateral symptoms. Sixteen were seen during the crisis. Nine of these patients had third-degree nystagmus. All presented symptoms of labyrinthine dysfunction and felt most comfortable while lying on the unaffected side with the eyes shut. Their symptoms became aggravated on opening of the eyes and changing of posture. There were no signs of a cerebellopontile-angle lesion. Nineteen patients had roentgenograms taken of the skull which included the internal auditory meatuses. The roentgenologic study did not show any changes in the internal auditory meatuses.

METHODS OF PROCEDURE

The object of the procedure is to inject medicaments transtympanically into the middle ear, so that the middle ear is filled with the solution and the round window of the labyrinth is entirely submerged.

By which route does the fluid injected into the middle ear enter the labyrinth? Absorption through the middle-ear mucous membrane, through the lymphatic system, or through the blood vessels seems to play no or only a minor role. Interchange of fluid through the oval window hardly takes place, because it is closed by the stapes and its capsule. Therefore, the only or chief avenue of ingress of the fluid from the middle ear is through the round window. This may occur because of fluid currents or by osmosis through the round-window membrane, which is a membranous boundary between the cochlea on the inside and the middle ear on the outside.

There are several possible causes of failure of the drug to pass into the inner ear:

1. The drug may escape through the Eustachian tube. We experienced this in the early phases of our work. The patients complained of a burning feeling or bitter taste in the throat and/or an alcoholic taste after intratympanic injection. In order to prevent this escape of fluid, we plugged the Eustachian tube through the nares with a petrolatum-saturated cotton-plug applicator. This was done under direct vision with the nasopharyngoscope. Thus, the Eustachian tube becomes obstructed, and the avenue of escape of the fluid is obviated.

2. The fluid may escape through the aditus ad antrum into the mastoid process, particularly in the pneumatized mastoid. To avoid this cause of failure, the patient's head should not be bent too much dorsally.

3. Since the pathological characteristics of Ménière's syndrome are due to a hydrops of the labyrinth, there is also the possibility that no osmotic interchange of fluid through the round window occurs during the period that the hydrops is at its maximum.

4. The possibility of individual variations in the permeability of the mucous membrane of the round window should also be considered. Animal experiments show that cocaine solutions pass with great regularity from the middle to the inner ear in cats, while in dogs the effect is variable. Further studies in animals, as well as in man, will have to ascertain how far individual factors play a part in this variability. This cause of failure perhaps can be overcome, at least partly, by measures that increase the permeability of the membrane in the round window.

In one case we mixed the injected fluid with hyaluronidase, and to our astonishment the reaction occurred within three minutes. This might have been a result of the activity of hyaluronidase that enhanced the passage of the drugs injected.

EQUIPMENT

The following equipment is used: (1) copper applicators; (2) sterile cotton; (3) nasopharyngoscope; (4) sterile ear speculums (three sizes); (5) 23 gage syringe, with 2½ and 3 in. (6.4 and 7.6 cm.) needles; (6) 35 to 50% alcohol solution, 2% cocaine solution, and 2% tetracaine hydrochloride solution. Anesthesia is not essential, but if desired (7) 10% cocaine with aniline oil, or (8) Bonain's solution (phenolized cocaine), is applied topically over the tympanic membrane.

POSITION

In placing the patient for this procedure, the head should be inclined toward the shoulder of the nontreated side, or the patient may lie on this side, so that the inner ear of the side of the injection lies below the middle ear. While slight dorsiflexion of the head may be helpful by raising the Eustachian orifice in the tympanic cavity, strong dorsiflexion of the head should be avoided in order to prevent escape of the fluid into the mastoid process.

OPERATIVE PROCEDURE

The operative procedure used is as follows:

1. Both nares are anesthetized with cocaine pledgets all the way to the nasopharynx, including the fossa of Rosenmüller, peritubal region, and orifice of the Eustachian tube on the affected side.

2. The Bonain solution and/or 10% cocaine and aniline oil are applied to the selected tympanic membrane for 15 min. when anesthesia is desired.

3. When nasal anesthesia has been produced, the nasopharyngoscope is passed through the naris opposite the side to be treated.

4. Under direct vision with the nasopharyngoscope, a copper applicator tipped with a small pledget of cotton, bent in the shape of the Eustachian catheter, is then passed through the adjacent naris, and the cotton is inserted into the Eustachian orifice so that it completely obstructs the Eustachian tube.

5. The nasopharyngoscope is withdrawn, but the applicator remains *in situ*.

6. One to 2 cc. of either 2% cocaine or 2% tetracaine solution, or 1 to 2 cc. of 35 to 50% alcohol, is then drawn into a small syringe and the latter fitted with a 23 gage 3 in. needle. The alcohol should not exceed 50% in strength because of the possibility of affecting the seventh nerve and producing a palsy.

7. The needle penetrates the posterior inferior portion of the tympanic membrane under direct vision with an ear speculum, and the needle is permitted to perforate the membrane just beyond the bevel.

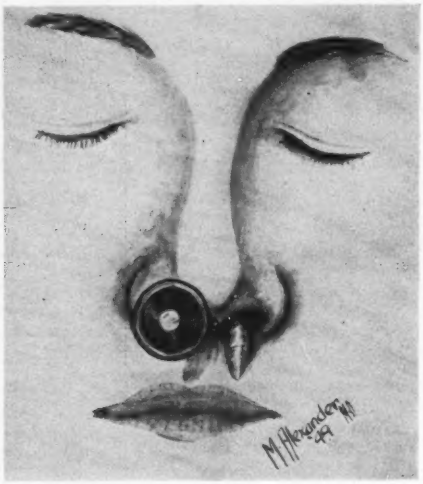

Fig. 1.—Nasopharyngoscope and applicator in position (left ear to be injected).

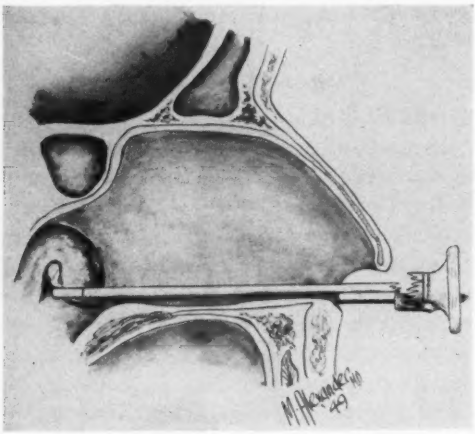

Fig. 2.—Longitudinal section showing nasopharyngoscope in position.

8. The fluid is permitted to flow relatively freely but very slowly from the syringe into the middle ear.

9. If the position of the head is correct, a sufficient quantity of fluid should enter the middle ear and cover the round window of the labyrinth, and, should the patient

have a burning sensation along the path of the Eustachian tube, this only indicates that an adequate amount of solution has been used to the point of overflowing.

10. No pressure is used at any time.

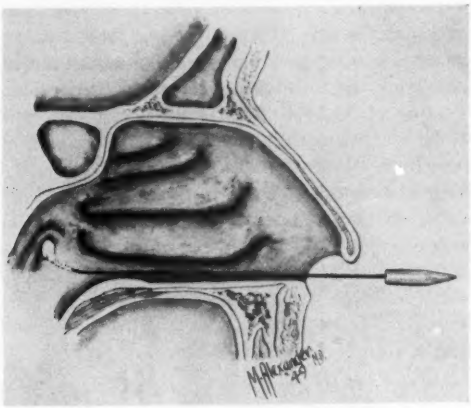

Fig. 3.—Longitudinal section of left side of nose showing applicator and cotton in Eustachian orifice.

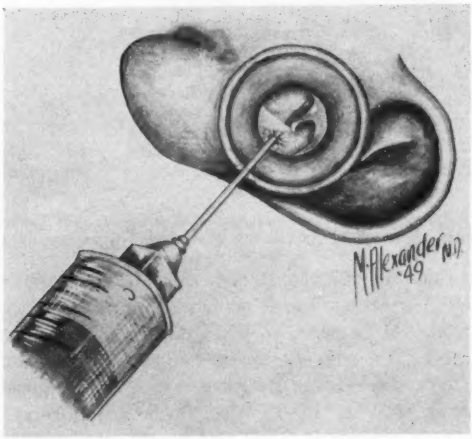

Fig. 4.—Site of transtympanic injection seen through ear speculum.

11. At the end of 30 min., the applicator is removed from the nose and the Eustachian tube.

PATIENT'S REACTION

There is a delayed reaction of approximately 20 min., at which time there develops a sensation of vertigo and deafness. In one case the reaction was delayed for 80 min. In case of a positive reaction there develop small nystagmoid excursions

to severe nystagmus, grade III with a slow component to the diseased side. This is accompanied with vagotonic nervous symptoms, such as nausea and vomiting. These symptoms may last for a few hours. There may or may not be an increase in tinnitus. If there is, this is not a persistent symptom, and eventually the tinnitus may disappear. Those patients who have subtotal conductive deafness benefit more readily by intratympanic injection. Unfortunately, most patients have perceptive deafness with a profound hearing loss. Therefore, one must not be concerned about the hearing loss following the intratympanic therapy. After injection there is a decided drop in hearing of 30 to 40 db. lasting four to six weeks, with gradual improvement, with the exception of those patients who have perceptive deafness. In patients with the conductive type of deafness the hearing loss is moderate, with a gradual improvement of hearing. Peculiarly enough, in spite of the hearing loss, we often observe that the reaction to Weber's test lateralizes to the side of the injection. In perceptive deafness, Weber's reaction lateralizes to the unaffected

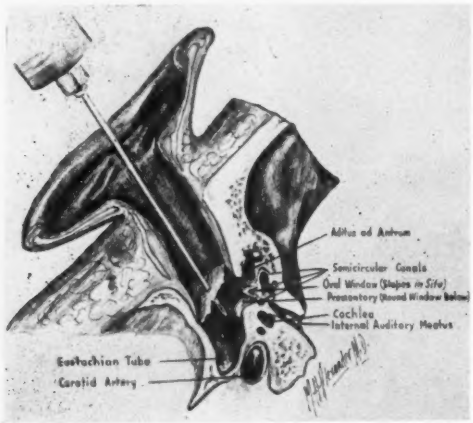

Fig. 5.—Cross section of ear showing direction of Eustachian tube (pointing up), dependent position of round window, and fluid gravitating toward the round fenestra.

side. Preoperative tinnitus and vertigo of peripheral origin subside when deafness produced by the injection is complete or profound.

The possibility should be borne in mind that in certain cases of irritation of central parts of the eighth nerve elimination of the impulses from the peripheral receptor also may be of benefit. In this respect it seems of interest that one of us (E. A. S.), together with Dr. H. T. Wycis, observed cases of thalamic pain in which this central type of pain was alleviated by interruption of the afferent pain-conducting pathways in the midbrain. Apparently the afferent impulses help to maintain the state of abnormal irritation of the respective centers. Whether some similar mechanisms play a role in states of irritation of the central part of the eighth nerve will have to be ascertained in further studies.

Another problem requiring further investigation is the experience that transient paralysis of the labyrinth by an anesthetic may be able to prevent the appearance of Ménière attacks for relatively long periods; in our longest case on record there was freedom from symptoms for six years.

It would be relatively easy to outline an explanatory hypothesis, such as interruption of a vicious circle by the transitory paralysis of the receptor apparatus. However, at present we wish to point only to analogies in other sensory systems, e. g., the long-lasting relief from anginal pain produced by transitory blocking of afferent cardioaortic fibers.

When no reaction occurs, it is possible that the fluid escaped through the Eustachian tube or into the mastoid process through the antrum, so that none of the fluid entered the labyrinth through the round window. No infection or complication resulted from the therapy.

CHANGES NOTED IN THE EARDRUM AFTER TRANSTYMPANIC INJECTION

The presence of bubbles is noted through the eardrum membrane. At first it appears pulsating, but soon the pulsation ceases. There is general congestion of the eardrum membrane with diffuse redness. Later the drum membrane appears grayish, but there are a gradual return of the eardrum luster and a return to normal landmarks. At times there remains a slight deflection of the cone of light. Sometimes there is a semitransparency of the eardrum membrane, while at other times the drum membrane appears hyperplastic. Small petechial hemorrhages are often noted in the peri-injection area.

TABLE 2.—*Results of Transtympanic Injection*

Number of Patients	Symptoms	Cured	Improved	Failures
37	Vertigo	11	9	17
	Tinnitus	19	..	18

Trowbridge [6] in his anesthesia for tinnitus aurium, empolyed 5% ethylmorphine hydrochloride solution; he states that tinnitus and hydrops of the labyrinth are the result of edema and pressure on neural fibers in the middle-ear cavity. It is our belief that the transtympanic injection of the anesthetics has a twofold action: one on the neural fibers of the middle-ear cavity, as described by Trowbridge, and the other on the labyrinth due to the entrance of the alcohol into the inner ear through the round window. The subsidence of the vertigo and the tinnitus chiefly is the result of the entrance of the drug into the labyrinth.

RESULTS

Of the series of 37 patients selected for transtympanic injection to alleviate vertigo primarily and tinnitus secondarily, good results were obtained in the majority.

SUMMARY AND CONCLUSIONS

Transtympanic injection offers a new approach for the treatment of Ménière's syndrome. While there is no one particular medical approach that will be a panacea for all types of vertigo and tinnitus, it is nevertheless gratifying to know that a good percentage of patients who received this type of medical therapy responded to it. We are of the opinion that in the individual case surgical treatment should not be given until medical treatment has completely failed.

6. Trowbridge, B. D.: Tympanosympathetic Anesthesia for Tinnitus Aurium and Secondary Otalgia, Arch. Otolaryng. **50**:200 (Aug.) 1949.

Transtympanic injection is a simple and practical procedure, and no harmful and untoward effects were noted. There was no seventh nerve palsy after the alcohol injection. No toxic reaction occurred after the cocaine and tetracaine hydrochloride injection. The tinnitus improved in 19 of 37 patients. The vertigo completely subsided in 11 and improved in 9 patients.

The instillation of the aforementioned drugs does not, of course, preclude the need of some patients for systemic or other medication aimed at relieving the underlying causes.

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OSTEOMA OF THE MAXILLARY SINUSES

Report of a Case

MILOVAN ĆURKOVIĆ, M.D.
ZAGREB, YUGOSLAVIA

IN THE modern literature descriptions of voluminous osteomas of the maxillary region are to be found seldom. Very large osteomas are described in the older literature,[1] mainly before the discovery of x-rays. Nowadays the diagnostic means are perfected and enable us to diagnose a tumor much more quickly. The most important diagnostic means for an early diagnosis of the osteoma is, without doubt, the roentgenogram.

The feature of these tumors is a histological benignancy and a slow growth, though this can lead to an invasion, to an injury of the wall of the cavity of the sinus and to a compression of the surrounding organs. Many experienced otolaryngologists never had an opportunity to see, in their many years of practice, an osteoma of the maxillary sinus. In my practice I had only now the opportunity to observe such an osteoma. The director of my department, Dr. A. Šercer, in his more than 30 years of operative practice, observed also only two cases of osteoma of the maxillary region.

In the whole literature there are described only 30 osteomas of the maxillary sinuses. Of these 30 Rawlins himself [2] had the opportunity to observe three. Most of them were small osteomas located in the sinus itself, while there were very few osteomas which had affected the anterior wall of the sinus too.

In my case a very large maxillary osteoma was in question that had originated from the maxillary region and penetrated into the surrounding organs and especially into the orbit, in which it had affected the greatest part of the bottom. This osteoma had penetrated also into the ethmoid and sphenoid regions as well as into the right nasal cavity and had also partially filled the cavity of the epipharynx. The weight of the tumor (roof and fragments) was 380 Gm.

A very interesting and comprehensive monograph regarding these tumors was written in 1938 by Malan.[3] He collected all the literature up to this date which described cases of osteomas of the paranasal cavities. In this monograph we find recorded 178 cases of osteomas of the frontal sinuses, 110 of the ethmoid and 41 of the maxillary sinuses, and there are also described seven cases of osteomas of the sphenoid sinuses. We can realize the frontal as well as the ethmoid sinus is most affected, while the maxillary and sphenoid sinuses are far more rarely affected.

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1. Carreras, Aragó, T.: Exotose éburnée du frontal, remplissant les cavités de l'orbite et du cerveau; présentation de la pièce pathologique, Rec. d'opht. 1881, **3**:223-229, 1881. Hilton, J.: Guy's Hosp. Rep. 1836, vol. 1.

2. Rawlins, A. G.: Osteoma of the Maxillary Sinus: Report of a Case, Arch. Otolaryng. **32**:499-505 (Sept.) 1940.

3. Malan, E.: Chirurgia degli osteomi delle cavità pneumatiche perifacciali (contributo anatomo-clinico), Arch. ital. di chir. **48**:1-124 (Jan.) 1938.

ETIOLOGY

Many hypotheses have been formulated in an attempt to explain the pathogenesis of the osteoma. Virchow [4] was of the opinion that the tumor originates in the inner layer of the bone (diploe) and that afterward it pushes outward, destroying thereby the lamellas on the surface of the bone. Some authors believe that the tumors originate in only the ethmoid cells, out of which the osteoma, in the stage of its growth, tries to penetrate into the frontal and maxillary sinuses; consequently on operative intervention some of these tumors are listed among the osteomas of the frontal or maxillary cavities although they originate in the ethmoid cells. This hypothesis is backed to a certain degree by the opinion of some authors that the ethmoid cells and the frontal sinuses have a common embryonic origin.

Dolbean believes that the periosteum of the cavity of the sinus becomes ossified and that in the further growth there arises a growing thickness under the mucous membrane of the sinus itself so that the neoplasm in its initial stage has no connection with the skeleton. According to his opinion quite independent tumors (at least independent in their beginning) are in question, and he recommends, therefore, that they be enucleated while they are small.

Rokitansky believes that ossified tumors of the cartilage are in question. The bulk of the authors believe, however, nowadays that osteomas originate from the rests of the embryonic cartilages. This pathogenesis seems to many writers to be the most probable one, taking in consideration the fact that this neoplasm most frequently arises on the junction of different bones (the ethmoid, frontal, and maxillary bones).

According to Causse's view [5] the proliferation of the bony cells of the diploe takes place as a consequence of little chronic inflammatory irritations. To this type of development he gives the name "enostosis." The growth of an osteoma arising in this way is in the direction in which the best conditions exist—i. e., toward the cavity of the sinus—either because no mechanical obstacles to its growth exist in the sinus or because it receives its nutriment from the periosteal layer and the mucous membrane which covers it.

Causse puts forward still another hypothesis, i. e., that osteomas can originate from the rests of embryonic cartilages in the ethmoid region, from which the tumor should extend itself on the maxillary sinus too. This second hypothesis Causse has built up also according to the theory of rests of embryonic cartilage which today has the greatest number of adherents.

As a reason for the origin of osteomas, trauma is also mentioned by many authors. According to different authors, trauma as a reason can be taken in consideration in 20 to 25 per cent of the cases only. We shall meet it oftener as a cause with men than with women.

It seems that in the development of these tumors there exist several reasons. There exists a great variability in the development of the tumor with regard to its seat; furthermore, inflammatory processes play an important part as well as the various histological structures. Malan is also of the opinion that there exists a double pathogenesis of these tumors. According to him, osteomas arise either from

4. Henke, F., and Lubarsch, O.: Handbuch der speziellen pathologischen Anatomie und Histologie, Berlin, Julius Springer, 1928, vol. 3, pt. 1, p. 229.

5. Causse, J.: Etude anatomo-clinique des tumeurs osseuses dysgénétiques ou ostéomes du sinus frontal, Ann. d'oto-laryng. Nov. 1934, pp. 1113-1149.

the rests of embryonic cartilages which remained unused during the completion of the entire craniofacial architecture or from the periosteum in its osteogenic stage (the growth of which is slow but constant). According to Malan, an endotumoral bony metaplasia can take place as well.

Older theories which tried to bring osteomas into a connection with syphilis and tuberculosis are abandoned today. In the recent literature [6] more attention is paid to the factors of nutrition as well as of metabolism of the organism.

PATHOLOGY

In the histological structure of the osteomas of paranasal cavities we find many a feature of normal bony tissue. Consequently we can find bony lamellas, bony cells, Haversian canals, adipose cells in the marrow and a great many blood vessels. Contrary to a normal bone, we find on histological examination of the osteoma that the compact as well as the spongy tissue is located very irregularly on the bony lamellas.[7] The medullar substance transforms itself, in many places, into fibrous tissue, and blood vessels appear in a much greater number than in normal bones.

With regard to single elements which prevail in the bony tissue, we distinguish the following kinds of osteomas (as in Roussy's classification [8]): osteoma eburneum and compact, spongy and mixed osteomas. From the point of view of pathology we count the osteoma among the benign tumors composed of bony tissue in different variations.

In the eburnean osteoma the histological picture shows very few Haversian canals, which sometimes do not appear at all, as well as marrow and blood vessels, while there can be found many bony lamellas differently located and very compact. This form is a very rare one.

The compact osteoma, according to its histological picture, resembles most the normal bone. The histological picture shows many Haversian canals containing blood vessels and concentric bony lamellas in which there are osteoblasts.

The spongy osteoma is the so-called medullar osteoma (according to Virchow). On the periphery of these osteomas there exists a zone of compact bones with bony walls containing very few Haversian canals. The spaces between the bony walls are filled with marrow containing connective tissue, blood vessels, leukocytes and osteoblasts. Sometimes islands of cartilaginous tissues can be found too.

The mixed osteoma seems to be the most frequent one (Brunner and Spiesman [9]), as pure eburnean, compact or spongy osteomas are to be found very seldom. These tumors can contain features of the tumors described above.

The forementioned classification [10] seems to be merely a theoretical one. The age of the tumor itself probably causes various changes in its structure. It seems that the osteoma in its development passes through different stages, the spongy, mixed and compact up to the eburnean, and it is likely that the latter represents the final stage of the development of the tumor.

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6. Hallberg, O. E., and Begley, J. W., Jr.: Origin and Treatment of Osteomas of the Paranasal Sinuses, Arch. Otolaryng. **51**:750-760 (May) 1950.

7. Eckert-Möbius in Denker, A.: Handbuch der Hals-, Nasen-, Ohrenheilkunde, Berlin, Julius Springer, 1929, vol. 5.

8. Roussy, G.: Le cancer, Paris, Masson & Cie, 1929.

9. Brunner, H., and Spiesman, I. G.: Osteoma of the Frontal and Ethmoid Sinuses, Ann. Otol., Rhin. & Laryng. **57**:714-737 (Sept.) 1948.

10. Villata, I.: Osteomi ed osteosarcomi delle cavita paranasali, Valsalva **19**:225-258 (Aug.) 1943.

These tumors [11] we must distinguish from the exostoses which represent bony products originating from an inflamed periosteum, are usually fixed on a wide bases and of a limited growth directed outward. Furthermore we must distinguish them from hyperostoses, which are nothing but a total hypertrophy of the bony walls of the sinus (leontiasis ossea—Virchow). Likewise we must differentiate the osteomas from osteophytes, which some writers regard as the initial stage of the exostoses. They also are of periosteal origin as a consequence of consecutive inflammatory irritations forming multiple bony outgrowths of small volume.

Ewing [12] is of the opinion that in certain cases it is very difficult to differentiate a neoplastic hyperplasia from an inflammatory one and that consequently a diagnosis of the osteoma represents a hard task.

MACROSCOPIC ASPECT

The osteomas can, partially or totally, occupy the cavity of the sinus. They are of a hard consistency and of different sizes and weights. Rarely they are to be found loose in the sinuses. Usually they are connected to the wall of the sinus with a bony pedicle of varying length and width. In its growth the tumor penetrates the bony wall by which it is delimited and comes out on the surface. Usually the osteomas assume the form of the cavity they are affecting, and the easiest direction for them to spread is the one in which on the wall they find the least resistance. They have a smooth surface and ivory-like color without pointed bleedings. They can be easily differentiated from the normal bone by which they are delimited.

SYMPTOMATOLOGY

The symptomatology of the osteoma which affects the maxillary sinus is a very various one.[13] As long as the osteoma is small and located in the sinus itself it is possible to diagnose it only by roentgenogram. In the manifest period as well as in the period of the exteriorization there arise headaches on the affected side, neuralgia of the upper jaw, movability of the upper teeth, erosions and changes in the form of the palate itself, mucous-pus discharge and nasal stenoses. On the affected side there appears a swelling which is hard, immovable and insensible to pressure.

REPORT OF CASE

The patient, aged 29, was admitted to my department in the hospital in July 1950. The familial anamnesis did not show anything particular. She had had no childhood diseases. In her eighteenth year she had had pleuritis. Three years ago she noted that the right side of her face was swollen. This swelling was growing from month to month and reached such a dimension that her face became deformed. The tumor protruded frontally and laterally. The patient never had pains or other troubles. She came to me asking that the swelling be removed for "esthetic reasons."

The examination showed a very large tumor, which had affected the whole maxillary region. The tumor was pressing the whole bony nasal pyramid as well as some parts of the nose toward the left side and bent the vestibulum oris out from the right side (fig. 1). The

11. Salvadori, G.: Contributo alla studio degli osteomi del seno frontale, Arch. ital. di otol. **11**:539-554 (Nov.) 1940.

12. Ewing, J.: Neoplastic Diseases: A Treatise on Tumors, ed. 4, Philadelphia, W. B. Saunders Company, 1940, cited by Hallberg and Begley.[6]

13. Berger, M.: Les ostéomes des sinus péricraniens (sinus frontaux, cellules ethmoidales, sinus sphénoidaux): Le diagnostic des néoformations osseuses craniofaciales, Rev. laryng. **71**: 301-370 (July-Aug.) 1950.

hard as well as the soft palate was bent out too. It had affected the right zygomatic region and the bottom of the orbit. The teeth were fixed firmly. The anterior rhinoscopy showed that the right nostril was completely stenosed while in the left nostril the septum nasi was pressed toward the lateral side.

The roentgenogram (fig. 2) showed a large irregular cloudiness the size of a fist. The cloudiness was darker in the central parts of the maxillary region and brighter in the anterior

Fig. 1.—*A* and *B* prior to operation. *C*, after operation.

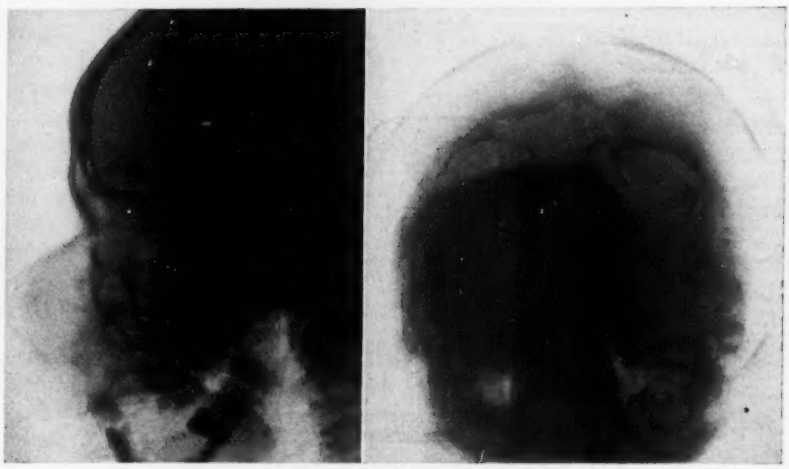

Fig. 2.—Lateral and anteroposterior roentgenograms taken prior to operation.

as well as in the posterior parts. With the roentgenogram I was able to make certain that the tumor had affected the ethmoid region too, the bottom of the orbit and the zygomatic region and that it had also extended toward the hard and soft palate.

The tomogram showed that between the bony walls there existed single cavities with a compact cortex, while inside the tumor there appeared cystic cavities.

All internal as well as clinical examinations made before the operation took place gave no significant results. An examination of the eye and the fundus did not show anything particular. The Wassermann reaction was negative.

The incision made in the skin was lateral to the right side of the nose, and a medial incision was made in the upper lip. The horizontal incision of the upper gingival fornix extended to the height of the last molar.

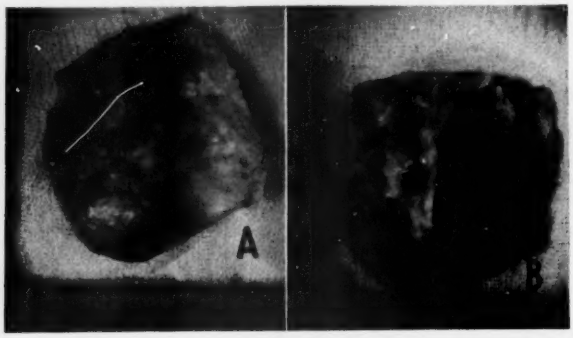

Fig. 3.—The roof of the tumor seen from the exterior and interior sides. *A*, the uneven surface of the osteoma can be observed. *B*, pseudocystic material from the interior side.

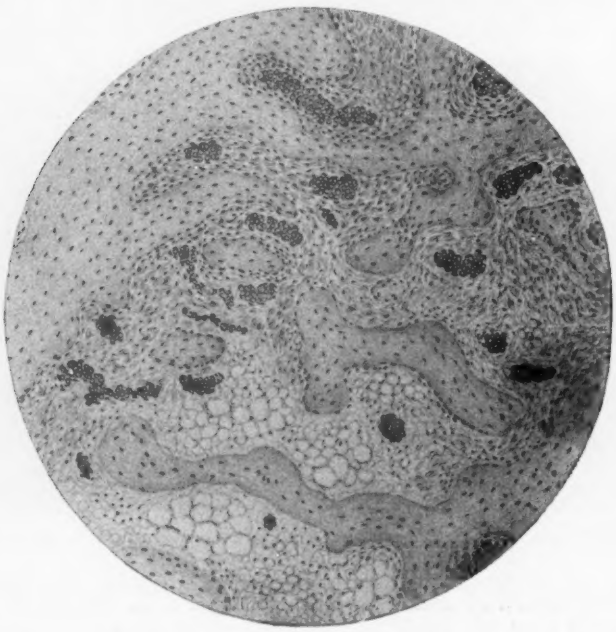

Fig. 4.—Osteoma mixtum. The tissue of the tumor has been built up by bony walls. Between the walls there is a connective tissue as well as rests of fat tissue (× 100).

When I had dislocated the soft parts toward the lateral side I found a large bony tumorous outgrowth, stone hard and firmly fixed toward the bottom of the orbit and the zygomatic

region as well as toward the hard palate. I was immediately aware of the impossibility of removing the tumor as a whole. I therefore first chiselled off its bony roof (by means of chisel and hammer) (fig. 3). When this was performed I found inside large cavities separated by bony walls. The cavities were filled with a yellow-green liquid. The tumor had affected the whole maxillary bone and the zygomatic region and had penetrated into the right side of the nose as well as into the ethmoid region and the bottom of the orbit. I was able to remove only the roof of the tumor by chiselling around the compact bone while the rest of the tumor I removed in single fragments.

The postoperative recovery was uneventful, and the patient was discharged from the hospital 30 days after the operation.

The patient had received before as well as after the operation 3,000,000 units of penicillin and 25 Gm. of sulfonamides.

The preparation was a large bony tumor, sharply separated from the tissue of its surroundings. The tumor pressed against its surroundings but did not infiltrate them.

The peripheral parts of the tumor were very compact, the walls of the bone thick containing quite ripe bony cells. Between the walls there was a considerably compact tissue containing fairly numerous, comparatively wide blood cells. Toward the center the bony walls were thinner, the spaces between them wider, the connective tissue in them more rarefied and the blood vessels wider.

The central part of the tumor had neither bony walls nor connective tissue and was filled with a serous sanguinolent liquid (fig. 4).

The diagnosis was osteoma faciei mixtum pseudocysticum haemorrhagicum permagnum (the diagnosis according to Docent Dr. Knežević).

SUMMARY AND CONCLUSIONS

Large osteomas of the maxillary sinus are rarely described in the modern literature. With regard to the origin of the osteomas there exist various hypotheses; consequently we can conclude that the etiology of these tumors is not revealed definitely.

From the histological and the clinical points of view we count the osteomas among the benign tumors, but in view of their slow but progressive expansion toward the surrounding organs, namely, the endocranial and orbital cavities, they can lead to lethal complications too unless this danger is removed in time by surgical intervention.

The death rate due to osteomas of the maxillary region is less than that due to osteomas of the ethmoid and sphenoid regions. In the recent literature, of 41 osteomas of the maxillary region only a few weighed more than 300 Gm. All others were very small tumors most of which protruded into the sinus itself. In older literature the largest and heaviest osteoma, weighing 587 Gm., was described by Carreras Aragó; others were described by Hilton as weighing 440 Gm. and by Goris as weighing 320 Gm. The danger, however, that the tumor might penetrate into the surrounding organs is not so much dependent on its size and weight as on the place in which the tumor is located as well as its growth.

With large maxillary osteomas the greatest danger lies in the penetration of the tumor into the orbit (as in our case in which the tumor had deeply affected the bottom of the orbit) and into the ethmoid region, as well as through the lamina cribrosa into the endocranium.

Of the described large osteomas of the maxillary region, the most frequent are the mixed osteomas. In the literature no case of a large eburnean osteoma of the maxillary region is described. These forms are the rarest ones, and it seems that they represent the ultimate stage in the development of the osteoma.

Case Reports

LYMPHOSARCOMA OF THE TONSIL

Review of Literature and Report of Two Cases

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LYMPHOSARCOMA of the tonsil is rare in the adult and very rare in the child. Its cause is unknown. Five cases of its occurrence in children have been found reported in the literature. Cline [1] in 1911 reported a case of sarcoma of the tonsil in a 22-mo.-old child; the tumor was removed, but there was recurrence, the tumor enlarging rapidly in all directions and causing death two weeks later. In 1931, Chappell [2] reported the case of a 7-yr.-old child. He performed a tonsillectomy; three weeks later the mass had regrown. In spite of x-ray therapy, the mass extended in all directions, and the patient died five weeks after the tonsillectomy. Daufman [3] records a case of lymphosarcoma in a 5-yr.-old boy, but details are lacking. Lopez [4] reported a lymphosarcoma in a 3-yr.-old boy; the patient died rapidly in spite of two extirpations, x-ray therapy, and a tracheotomy. Morwitz,[5] in 1947, reported a case in a 3-yr.-old boy with concomitant nasal allergy, producing symptoms of nasopharyngeal and nasal obstruction. Two attempts at removal of the tumor and x-ray therapy failed to prevent fatal issue four months after the onset of a generalized lymphosarcomatosis with marked involvement of the superficial and deep cervical lymph nodes, of a kidney and of the mesenteric glands.

Our first case would be in accord with the belief expressed by Mallory [6] that all types of lymphoblastoma (lymphocytoma, lymphoma, lymphosarcoma, lympholeukemia, Hodgkin's disease, plasmocytoma and giant lymph-follicle hyperplasia) are different manifestations of one disease. Clinically, from the tonsillar standpoint, our first case was one of lymphosarcoma; from a pathology report made by Dr. Eugene A. Case on a punch biopsy a tentative diagnosis of lymphosarcoma was made; the diagnosis of the consultant pediatrician was acute lympholeukemia.

Early diagnosis is not always easy, and several biopsies should be performed before the possibility of tumor is discarded. Whitcomb [7] states that in five of his

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1. Cline, L. C.: Report of a Case of Sarcoma of the Tonsil in a Young Child, Laryngoscope **21**:153, 1911.

2. Chappell, R. S.: Lymphosarcoma of Left Tonsil, J. Indiana M. A. **24**:372, 1931.

3. Daufman, cited by Chappell.[2]

4. Lopez, A. G.: Lymphosarcoma of the Right Tonsil in a 3 Year Old Boy, Bol. Soc. cubana de pediat. **13**:343, 1941.

5. Morwitz, S. M.: Lymphosarcoma of the Tonsil in a 3 Year Old Child, Ann. Otol. Rhin. & Laryng. **56**:892, 1947.

6. Mallory, F. B.: The Principles of Pathologic Histology, Philadelphia, W. B. Saunders Company, 1914, p. 325.

7. Whitcomb, C. A.: Sarcoma of the Tonsil, Arch. Otolaryng. **38**:1 (July) 1943.

seven cases the first biopsy specimen did not contain neoplastic tissue although the disease was sufficiently advanced to arouse suspicion of sarcoma. Lymphosarcoma may have developed only in the depth of the mass or in one area at first. This accounts for failure to discover it microscopically.

Clinically, tonsillar lymphosarcoma is characterized by marked hypertrophy of one tonsil, which may be two or three times normal size. The tumor presents a dull hyperemic appearance with rounded contours and a nodular surface. It is soft and cystlike, and often becomes ulcerated and bleeds easily. In the differential diagnosis, infectious adenopathy and lymphatic diathesis must be considered; in these conditions there is enlargement of lymph nodes of moderate degree, and they are not so progressive in their extension. In these conditions pain is much more pronounced.

Before any treatment is started, as stated by Whitcomb,[7] a general physical examination should be done, with special care given to palpation of the neck and the axillary and inguinal regions; the abdomen should be examined carefully to exclude abdominal metastases. Roentgenographic studies of the chest are essential, and roentgenograms should also be made of the skeleton or any part of the body which has felt different since the onset of symptoms referable to the throat or the appearance of a mass in the neck.

The treatment consists, first, in a tonsillectomy, removing the malignant tumor as completely as possible, and, second, in x-ray therapy.

The prognosis is poor and should be guarded, because the patients are usually not seen and treated early enough to justify hope for a permanent cure. This is due mainly to the fact that the first phase of this disease is almost symptom free. Another cause of failure in the treatment of lymphosarcoma is the fact that the patients think they are cured when the nodes recede. A permanent cure would be possible if the patient were seen early, e. g., when the lymphosarcoma is limited to a single region and confined to a small cluster of nodes, because in such a case the various cells are very sensitive to x-ray therapy and the irradiation may be concentrated in one area. However, according to Desjardins,[8] if the process has invaded two or more groups of nodes in different regions, a cure is impossible and the most that can be expected is a variable degree of improvement for an indefinite period. When lymphosarcoma is not too advanced and especially when it is of a relatively chronic form, the patient's condition may show great improvement and he may survive from five to 20 yr. or even longer. Desjardins[8] recommends that each field be given in one or two days as large a dose of x-rays as is possible without taxing the tolerance of the skin and other tissues or of the patient as a whole, and to continue this therapy with short intervals between treatments and a rather high dose at each session. In a case of the acute form of lymphosarcoma, x-ray treatment may be followed by exceptionally rapid regression. However, this is of short duration. In the chronic form the regression would be less marked and more prolonged. A criterion for the estimation of the advancement of the disease is the numerical status of the red blood corpuscles. Infiltration of the skin, of the subcutaneous tissues or of such organs as the ureter, kidney and adrenal gland is usually a late manifestation.

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8. Desjardins, U.: Lymphosarcoma and Hodgkin's Disease: Problems in Roentgen Therapy, Radiology **39**:16, 1942.

In view of the importance of an early diagnosis and of surgical treatment for a permanent cure, it must be emphasized that a unilateral enlargement of a tonsil, even in a child, is highly suggestive of lymphosarcoma. Unilateral cervical node enlargement when progressive and unaccompanied with tenderness should be considered first as malignant and second as metastatic.

In our first case, tonsillectomy had been postponed twice, once because of pertussis and the possibility of pneumonia complicating ether anesthesia (antibiotics were not available to us in 1943) and once because of the patient's poor condition when the diagnosis of so-called acute lympholeukemia was made.

REPORT OF CASES

Case 1.—R. H., a 4-yr.-old white boy, was hospitalized on April 27, 1943, because of high temperature and a draining left ear. He had had acute nasopharyngitis two weeks before, and on subsidence of symptoms the ear condition started. A diagnosis of acute left purulent otitis media and acute left mastoiditis was made. A routine chest x-ray revealed an enlargement of the thymus. The blood cell count on the day of admission showed 3,670,000 red cells, with 71 per cent hemoglobin (11 Gm.), and 7,500 white cells (78% polymorphonuclear leukocytes, 22% lymphocytes, 40% segmented forms and 38% nonsegmented forms). After treatment with sulfadiazine, myringotomy and x-ray therapy (110 r to the mastoid and 800 r to the thymus), the patient was discharged in good condition on May 5. During and subsequent to the aural infection, the anterior cervical lymph nodes were enlarged. There was a slight enlargement of the tonsils and adenoids with injection of the nasal and pharyngeal mucosa.

When seen on June 14, the patient had no ear or nose symptoms or increase in adenopathy or tonsillar enlargement. He returned to the office on July 19 to arrange for an adenotonsillectomy. The history suggested pertussis, and at this time there was noted for the first time the mass in the right tonsil and an increase in the size of the right cervical nodes. The tonsillar mass was moderate in size and appeared inflammatory. Adenotonsillectomy planned at this time was postponed because of the pertussis. On Aug. 9 the mass was much larger and not so hyperemic, and the veins of the pharyngeal mucosa could be seen extending over the surface of the mass. A punch biopsy specimen was taken. Unfortunately, punch biopsy yields such a small specimen from this situation that it is very difficult to determine whether one is dealing with lymphoid hyperplasia or lymphosarcoma, and in interpreting one's findings this must be taken into consideration. The specimen consisted chiefly of lymphoid tissue, though there was a small portion of mucous membrane. Lymphocytes were crowded together without any definite arrangement, as in germinal areas, etc. They appeared to be a trifle larger than the small lymphocyte. Scattered through them were mitotic figures which are not seen normally except in the germinal areas. From so small a bit of tissue it was somewhat difficult to make a diagnosis, but it was the opinion of the pathologist that the probabilities pointed to lymphosarcoma. The tentative diagnosis was lymphosarcoma. The patient was then treated with intraoral and external x-ray therapy—800 r intraorally, 1,200 r externally to the right tonsillar region and 1,200 r to the left tonsillar region. When the patient was seen on Aug. 23 after having received half of the total irradiation, the mass was definitely smaller and not so hyperemic, and the right cervical adenopathy was smaller. The patient was readmitted to the Episcopal Hospital on Oct. 6 for study, treatment, and a tonsillectomy if condition permitted. The chief complaints on admission were sore throat, mouth-breathing worse at night, weakness, and extreme pallor.

The family history was noncontributory except for the fact that a grandmother had died of generalized carcinoma.

On physical examination adenoids were noted to be present. The tympanic membranes appeared normal. The pharynx at this time was injected, and there was injection of the vessels of the anterior and posterior pillars and of tonsillar crypts. The tonsillar mass seen Aug. 14 had now apparently disappeared. The marked right anterior cervical adenopathy was greatly reduced by x-ray treatments, although the cervical lymph nodes were palpable.

The pediatric consultant reported on Dec. 2 that the child was still somewhat pale and anemic-looking but was apparently happy in spite of his condition. He had a swelling of firm

consistency in the region of each parotid gland. The lungs were clear; the cardiac action was regular and there was a definite apical systolic murmur. The abdominal skin tension was fair; the muscle tone was poor, and no masses were palpable. The liver was not enlarged. The spleen was palpable about 1 fingerbreadth below the costal margin. Potassium arsenite solution, 2 drops three times daily, increased 1 drop daily to tolerance, was prescribed.

Laboratory Report.—A complete blood cell count made on Oct. 6 showed 2,580,000 red cells, with 48% hemoglobin (7.5 gm.) and 37,700 white cells (3% polymorphonuclear leukocytes, 97% lymphocytes, 6% mononuclear leukocytes, 5% basocytes, 1% segmented forms and 2% nonsegmented forms). This should be compared with the complete blood cell count of April 27. Another blood cell count taken on Nov. 13 showed 1,850,000 red cells, with 26% hemoglobin (4 gm.) and 100,000 white cells (99% of the cells were embryonic lymphocytes, of which many were blasts). Practically no granulocytes or nucleated red cells were seen. A blood culture on Nov. 16 was negative. Repeated x-rays of the chest, skull, and long bones on Oct. 7 and Nov. 9 did not show any evidence of mediastinal lymphadenopathy or of bone pathology.

A throat examination on Oct. 31 revealed hypertrophy of the tonsils and adenoids and slight bleeding from the nasopharynx. In spite of blood transfusions, the child died Nov. 19 after a few peaks of temperature to 105 degrees, with a final diagnosis of acute lympholeukemia.

It is noticeable in this case that the enlarged thymus, which is a lymphoid structure, did not respond as usual to x-ray therapy and that three months later a lymphosarcoma was present in the right tonsil. As in the S. M. Morowitz case, the patient died approximately four months after the onset of symptoms and signs.

CASE 2.—J. C., a 56-yr.-old white man, was seen for the first time at the ear, nose, and throat outpatient clinic on Oct. 30, 1945, by an associate, who made a diagnosis of chronic tonsillitis with hypertrophy. He had been told one year previously by a physician that he had "diseased tonsils." The only symptoms attributable to the tonsils when he was first seen by us was pain in the right tonsillar region on swallowing, which he had complained of for the previous three weeks. The patient had lost 10 lb. (4.5 kg.) of weight during the past year. His general health was good. Tonsillectomy was advised. One of us (O. C. H.) saw the patient on Nov. 27, at which time the examination revealed both palatine tonsils to be considerably enlarged and hyperemic. There was no obvious suppuration of the tonsillar crypts. The right tonsil was larger than the left, and it bulged in its superior portion behind the anterior pillar. No area of ulceration was visible and no induration. There were a few firm, discrete, small, freely movable, nontender, submandibular lymph nodes, more on the right than on the left. Otherwise there was no remarkable lymphadenopathy. The results of a complete physical examination were negative. The impression was of chronic tonsillitis with hypertrophy of the palatine tonsils and lymphosarcoma of the right tonsil.

A tonsillectomy under local anesthesia was scheduled Nov. 29 but was not performed until Dec. 13, because the patient did not report to the hospital for operation until Dec. 12. Two ragged bits of tissue resembling tonsil were sent to the pathologist. He reported that the tissue was lymphoid. The normal structure of the node had been destroyed. Throughout there was an unmixed growth of small dark lymphocytes. In addition, only endothelial cells of vessels were present. The lymphocytes were slightly irregular in form, and the capsule appeared to be invaded. All other lymphomas could be ruled out. The pathologist's diagnosis was lymphosarcoma. After this report, the patient was given a course of x-ray therapy, 2,400 r to each tonsillar area in five weeks.

Chest roentgenograms taken respectively April 30, 1946, May 20, 1947, and Nov. 14, 1947, showed nothing significant except moderate displacement of heart and mediastinum toward the right. A blood cell count made on Dec. 17, 1945, showed 4,520,000 red cells, with 83% hemoglobin (13 gm.), and 6,300 white cells (70% polymorphonuclear leukocytes, 27% lymphocytes, 1% mononuclear leukocytes, 2% eosinophils; 49% segmented forms, and 21% nonsegmented forms), and 283,800 platelets. The patient was seen again Feb. 12, 1946, and the pharyngeal examination did not reveal any sign of lymphosarcoma at that time. He was advised to return every three months for recheck of his condition, but, unfortunately, he did not return until Feb. 22, 1949, at which time he complained of abdominal pain and was referred to the general surgical service. A physical examination revealed a generalized adenopathy, involving the cervical, supraclavicular, trochlear, axillary and inguinal lymph nodes. They

were of various sizes, the largest 2 cm. in diameter; all were discrete, movable, and nontender. Palpation of the abdomen revealed a nodule 4 cm. in diameter just beneath the skin and to the right of the umbilicus.

Cervical adenectomy was performed on Feb. 25, with a pathologist's report of lymphosarcoma.

The patient, showing clinical signs of cholecystitis, and a large calculus being shown on x-ray, underwent cholecystectomy March 8. Some nodes 1.5 cm. in diameter were removed from the region of the cystic duct. The pathological examination of these nodes was reported as revealing lymphosarcoma.

On February 22 a complete blood cell count showed 4,060,000 red cells, with 80% hemoglobin (12.5 gm.), and 9,600 white cells (72% polymorphonuclear leukocytes, 17% lymphocytes, 11% eosinophils; 56% segmented forms, and 18% nonsegmented forms). Feb. 23 a chest x-ray revealed a prominence of the mediastinum to the right of the thoracic spine, interpreted as a manifestation of mediastinal lymphosarcoma.

FOLLOW-UP OF CASE

On March 14, the patient now being an outpatient, an x-ray therapy course was started again and applied to various sites, e. g., neck, abdomen, axillary regions, mediastinum, and pelvis. A chest x-ray (June 22) showed a regression of the prominence of the superior mediastinum to the right.

The patient was seen again in the ear, nose, and throat clinic on Aug. 16, at which time the pharynx, mouth, and tonsillar region were free from any tumor mass. Hypertrophy of the lymphoid tissue about the lateral pharyngeal folds and several hypertrophied cervical lymph nodes were noted. His general condition was rather good in spite of his generalized lymphosarcomatous condition.

At his next ear, nose, and throat examination on Oct. 18, the hypertrophy of the lateral pharyngeal folds was about the same as seen on the previous visit, on Aug. 16. The lingual tonsils, however, were markedly hypertrophied and appeared smooth and pink. There was no further anterior cervical adenopathy. X-ray therapy to the lingual tonsils was advised.

Examination on Nov. 1, showed marked regression of the lingual tonsils following the above roentgen therapy. The patient did not return to the ear, nose, and throat dispensary until Feb. 21, 1950, despite instructions to return at monthly intervals. At this examination no gross evidence of lymphosarcoma was seen. His general condition appeared good, and the lymphosarcoma apparently did not interfere with his daily work.

LARYNGEAL HISTOPLASMOSIS

WILLIAM F. HULSE, M.D.
CLEVELAND

APPARENTLY Darling,[1] in 1906, was the first to recognize adequately the entity of histoplasmosis in man. Parsons and Zarafonetis,[2] in a review of 73 cases of histoplasmosis, found 10 cases of laryngeal involvement. Gammell and Breckenridge [3] reported two cases of laryngeal histoplasmosis in 1949, and Roberts and Forman [4] reported two more a year later.

Histoplasmosis is now recognized as a systemic disease which is characterized by its localized manifestations. It was not until World War II that extensive investigation in the United States seemed to show that this disease was, and is, more prevalent than formerly supposed. It has been pointed out that there are roughly two types of cases extant: first, the mild and transient and, second, the severe and fatal. The first is found more by accident accompanying some other condition, while the latter type will usually cause the patient to seek medical advice. The latter is usually fatal, inasmuch as the lungs, spleen, adrenal glands, and lymph nodes are frequently involved.

Probably the chief reason that the disease has been enigmatic is its close resemblance to tuberculosis. The fact that most adults over 21 yr. of age have a positive tuberculin skin reaction adds to the diagnostic confusion. A patient, then, who presents positive tuberculin and concurrently positive histoplasmin skin reactions is quite likely to find himself in an unfortunate prognostic position. Should a biopsy be done, he may still not be in the clear because of the fact that microscopically one disease closely resembles the other; unless special procedures and tissue stains are used, even a competent pathologist may be unable to differentiate these conditions. It was thought for many years that most, if not all, of the calcified nodules present in adult lung fields were monuments to preexisting tuberculosis. This assumption, of course, has now been proved false in the light of the observation that histoplasmosis also heals by calcification. The patient described in this paper had negative tuberculin and negative histoplasmin skin reactions. This fact should not add too much to the general confusion, inasmuch as these two testing agents are well known for their lability, as well as for their wide variations in strength.

The statements and conclusions published by the author are the result of his own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

Dr. Hulse is senior consultant, Department of Otolaryngology, Brecksville Veterans Administration Hospital for Tuberculosis, Brecksville, Ohio, and instructor, Western Reserve University School of Medicine.

1. Darling, S. T.: A Protozoon General Infection Producing Pseudotubercles in the Lungs and Focal Necrosis in the Liver, Spleen and Lymph Nodes, J. A. M. A. **46**:1283 (April 28) 1906.

2. Parsons, R. J., and Zarafonetis, J. D.: Histoplasmosis in Man, Arch. Int. Med. **75**:1 (Jan.) 1945.

3. Gammell, E. B., and Breckenridge, R. L.: Histoplasmosis of the Larynx, Ann. Otol. Rhin. & Laryng. **58**:249 (March) 1949.

4. Roberts, S. E., and Forman, F. S.: Histoplasmosis—a Deficiency Disease: Report of 2 Cases with Laryngeal Involvement, Ann. Otol. Rhin. & Laryng. **59**:809 (Sept.) 1950.

REPORT OF CASE

D. M. K., a 58-yr.-old white man, was admitted to the Brecksville Veterans Administration Hospital with a diagnosis of tuberculous laryngitis with symptoms of extreme hoarseness, laryngeal pain, dysphagia, and general debility. The onset of his symptoms was in December, 1948. He consulted a private physician because of his hoarseness and laryngeal pain, and a biopsy was performed for his ulcerative laryngitis. This was reported as showing tuberculosis, and he was treated with streptomycin, even though acid-fast bacilli were not observed. During the streptomycin regimen his symptoms became worse. Chest roentgenograms taken at this time revealed thin-walled cavitation on the left, with increased hilar markings; for the outlined reasons he was admitted to this hospital for tuberculous patients. Another biopsy was done, and an extensive search made for tuberculosis organisms was negative. Several spherules were noted

Photograph showing histoplasmotic involvement of the larynx in patient D. K.

in the fresh tissue smear from the biopsy specimen. Because of the fact that he was considered to be nontuberculous, he was transferred to Crile Veterans Administration Hospital, Cleveland, after a short stay at home.

In addition to the above findings, he was discovered to have positive blood and spinal fluid Kahn reactions. Because of these reactions he was given antisyphilitic therapy, although it was felt that his laryngeal lesion did not represent syphilis.

During his stay in the Veterans Administration Hospitals he had intermittent fever which did not appear to be characteristic. His blood picture showed a moderate anemia, but the white blood cell picture was roughly within normal limits except for an occasional increase in the eosinophils. The lung fields showed progressive pathological involvement. Blood and laryngeal cultures became positive for Histoplasma capsulatum. He subsequently presented a paresis of his right side, later went into generalized convulsions, and finally died in August, 1949, approximately eight months after his first laryngeal symptoms appeared.

Postmortem examination revealed extensive laryngeal involvement, as shown by the accompanying photograph. In addition, there was marked involvement of the lungs, with cavitation of the upper lobe of the left. There was a confluent, diffuse bronchopneumonia with involvement of all lobes. Hyperplasia of the spleen and lymph nodes and a diffuse chronic inflammation and perilobular fibrosis of the liver were present. In addition, a large infarct in the anterior lobe of the pituitary gland and another in the left cerebral hemisphere were seen. Also noted were chronic pyelonephritis and cholecystitis and slight chronic leptomeningitis.

COMMENT

A case of generalized histoplasmosis with localized laryngitis is reported.

A review of the literature indicates that the many mild and the very few severe cases of histoplasmosis with survival have responded to no known medication. The few patients who have apparently recovered from a severe episode evidently did so spontaneously. Several points of similarity have been pointed out between tuberculosis and histoplasmosis which have led to diagnostic perplexity. There are two important points which may aid in clarifying this confusion. First, laryngeal tuberculosis is never primary and always occurs in the presence of open and advanced pulmonary involvement; secondly, of the several hundred patients with laryngeal tuberculosis seen since the advent of streptomycin therapy, I have never seen one whose condition did not respond, at least to some extent, to treatment with this antibiotic, unless the patient was moribund. If there is pain in laryngeal tuberculosis, moderate doses of streptomycin will almost always abate this symptom within one week; this is in direct contrast to laryngeal histoplasmosis, in which either the streptomycin treatment will have no effect or the pain will become worse. Administration of this medicament may be used, then, as a therapeutic test for a few days, and no harm is likely to be done.

Parts of this report and the photograph are presented through the courtesy of Crile Veterans Administration Hospital, Cleveland.

OTOSCLEROSIS

An Index of the Literature, with Abstracts, for 1948-1949

THIS IS the fifth additional installment of Volume IV, "Otosclerosis," to be issued by the Central Bureau of Research of the American Otological Society, Inc.[1] Owing to the unavoidable delays incident to publication in 1948 and 1949, the index for both of these years is included in this installment. Volumes I, II, and III are now out of print.

Many papers have been so well abstracted in various medical journals and especially in the *Excerpta Medica* that the abstracts could hardly be improved upon. In several instances the conclusions or the abstracts have been quoted almost verbatim. In such instances they are marked with quotation marks or appear in smaller type.

All titles are given in English, but the names of the mediums of publication are printed in the language of the original.

The selection of articles abstracted implies no endorsement or condemnation, and the opinions of the authors are quoted without comment. The very large number of articles on the fenestration operation and their repetitive character have made it advisable not to abstract the great majority of them. Many are merely reviews.

Again I am indebted to Dr. Franz Altmann for his continued cooperation and aid in the translation of the foreign literature.

A reprint of this installment with index of authors according to subjects and perforated for loose-leaf binding in Volume IV of "Otosclerosis" may be obtained for $1.00 from

EDMUND PRINCE FOWLER, M.D., *Editor*
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1. The Central Bureau of Research (originally the Committee on Otosclerosis) of the American Otological Society, Inc., is constituted as follows: Board of Trustees of the Research Fund: Marvin F. Jones, M.D., Chairman, New York; Edmund P. Fowler, M.D., Secretary, New York; Lawrence R. Boies, M.D., Minneapolis; Gordon D. Hoople, M.D., Syracuse, N. Y.; William J. McNally, M.D., Montreal, Canada; Philip E. Meltzer, M.D., Boston; D. E. Staunton Wishart, M.D., Toronto, Canada. Member Emeritus, D. Harold Walker, M.D., Boston. Advisors to the Board: (legal) Samuel Lloyd; (financial) Walter C. Baker. Consultants to the Board: Madison Bentley, Ph.D., LL.D., Professor of Psychology Emeritus, Cornell University; J. B. Collip, M.D., D.Sc., F.R.C.P., F.R.S., Professor of Medical Research, University of Western Ontario; Stacy R. Guild, Ph.D., the Johns Hopkins University; Oscar Riddle, Ph.D., LL.D., D.H.C., Plant City, Fla.: R. Lorente de Nó, Rockefeller Institute for Medical Research, New York.

Altmann, F., and Woodman, DeG. Otosclerosis: Its Pathology and Treatment, *New York J. Med.* **48:**173, 1948.

The authors discuss the pathology, clinical symptomatology, and surgical therapy of otosclerosis. They report their own experiences gained in more than 100 cases with operation. There is in suitable cases a 60% chance for permanent restoration of "practical hearing," in 35% a dubious chance, or definitely no improvement but, sometimes, what the patients think to be satisfactory results. In 5% the hearing becomes definitely worse or is entirely lost. Even though the hearing aid provides greater amplification, it may produce a less satisfactory hearing result from the patient's standpoint than a successful operation. In spite of the remarkable progress in otosclerosis research during the last 50 years, many problems remain unsolved. The most important is that of etiology, which is still as puzzling as ever. Only after a complete clarification of the cause of the condition can we hope to find the means for prevention of, or an actual cure for, otosclerosis. Although the surgical treatment is only a palliative procedure, which does not eliminate the disease, its significance can hardly be overestimated.

Amidon, E. W. Heredity and Environment in Otosclerosis, *J. Hered.* **39:** 223, 1948.

This article is a review of the genetics of otosclerosis and its distribution and histology. The author estimates that about 10 million persons harbor otosclerotic foci. Davenport is cited to the effect that when the mother alone is affected the otosclerosis will be common in the sons; when the father alone is affected, it will be less common in the sons. Otosclerosis may be an irregular dominant with variation in penetrance from hereditary and environmental causes.

Anguelouchev, J. The Struggle Against Deafness, *Ann. méd., Sofia* **40:** 42, 1948.

Anson, J. B., and East, T. H. The Development of the Otic Capsule in the Region of Surgical Fenestration, *Quart. Bull. Northwestern Univ. M. School* **23:** 465, 1949; *Tr. Am. Otol. Soc.* **37:** 54, 1949.

About midway in fetal life the otic capsule becomes fused into a single bone with adult dimensions. The ossification spreads from 14 centers. The periosteal layer is formed in a similar manner as in the long bones of the body, and the inner layer of the capsule is formed from the endosteal walls of labyrinthine spaces. Cartilage islands may persist in the middle layer of the capsule throughout life. When formed, endochondral bone shows no reconstructive changes taking place. It remains in its primary state. In the region used for surgical fenestration the recently formed periosteal bone undergoes resorption at the 22d week of fetal life. The mucoperiosteal membrane, therefore, covers the secondary bone rather than the original periosteal bone. The area used for surgical intervention thus differs from the remainder of the otic capsule in this respect.

Anson, B. J., and Cauldwell, E. W. The Fissula ante Fenestram of the Human Temporal Bone, *Anat. Rec.* **94:** 146, 1946.

This is a review of what is known concerning the perilymphatic connective-tissue channel between the vestibule and the middle ear. The channel is lined by a thin layer of cartilage, and its perichondrium may at times become activated and cause almost complete filling up of the area. Rarely, this cartilage may be replaced by sclerotic bone, or in young persons it may be considerably enlarged.

Anson, B. J.; Cauldwell, E. W., and Bast, T. H. The Fissula ante Fenestram of the Human Otic Capsule: I. Developmental and Normal Adult Structure; II. Aberrant Form and Contents, *Ann. Otol. Rhin. & Laryng.* **56:** 957, 1947; **57:** 103, 1948.

This paper must be read. The authors' conclusions follow:

1. The histologic structure of the antefenestral region of the otic capsule, between the vestibular window and the cochlea, is exceptional in that it consistently includes a cleft-like fissula occupied by unmodified connective tissue. This fissula ante fenestram extends vertically from the scala vestibuli to the tympanic cavity near the hamulus for the tensor tympani tendon.

The fissula appears in the 34 mm. stage through invasion of the primordial cartilaginous capsule by the periotic connective tissue of the vestibule; with maturation, the periotic invagination becomes the connective tissue content of the fissular tract.

During the process of ossification of the otic capsule, cartilage persists as the lining of the fissula. At its periphery endochondral bone forms, as early as the midterm stage, an investing osseous shell.

Peripheral islands of calcified cartilage (intrachondral bone) occur abundantly about the fissula and throughout the fissular region.

Typically, the fissula is an open S-shape in anterior coronal outline, narrow and cleft-like, and occupied by connective tissue. The superior or tympanic part is commonly twisted at a 90-degree angle in relation to the inferior or vestibular portion.

Variation in size and form is common. Occasionally the body of the fissula is capacious; it then has the appearance of a pouch rather than a cleft.

The widened fissula may be occupied, in whole or in part, by a cartilaginous mass, which can encroach upon the stapedial ligament in the presence of an auxiliary, or fenestral, orifice.

The fissular area is one of great histologic instability, a circumstance which renders it vulnerable to pathologic change, the vestibular window subject to invasion, and the stapes liable to fixation within its fenestra.

II. The antefenestral region of the human otic capsule is regularly crossed by a cleft of perilymphatic nature, the normal content of which is a slightly vascular connective tissue. This cleft, the fissula ante fenestram, is typically narrow and usually no greater in vertical height than the distance between its two regular orifices: one upon the tympanic cavity anterior to the vestibular window, and the other into the vestibule at the site of junction with the scala vestibuli.

Frequently in fetuses, infants, and children, the fissula is unusually large. In such cases, it contains a mass or nodule of newly formed cartilage derived from the chondral wall of the fissula. Such a cartilage mass may occupy part or all of the fissular tract and may reach the vestibular window when an auxiliary, or fenestral, orifice occurs. The new cartilage mass forms at the expense of the original connective tissue. Two types of active cartilage are observed: one type is local and self-limiting and usually does not obliterate the fibrous fissula; the other is more vigorously proliferating and may obliterate not only the fissular cleft but extend into the surrounding marrow spaces and impinge upon intervening bony trabeculae. In all cases observed, the latter type of cartilage is wholly different from the mature cartilage surrounding the fissular tract, since it shows evidence of marked cellular activity or tinctorial changes in the matrix characteristic of a stage preparatory to ossification. Later, in the advanced fetus or in the infant, either areas of newly formed gnarly bone may be found, or resorption and rebuilding of bone in the fissular area may occur.

Since the fissula ante fenestram in some specimens of developing otic capsules is capacious beyond regular dimensions, it appears that the invasive periotic tissue, during the process of formation, passes beyond ordinary bounds to produce a large tract. When histologic maturation of this relatively extensive zone of elementary connective tissue is effected, the production of cartilage serves to obliterate part or all of the fissular contents.

These observations permit a correlation between the occurrence of large fissulae and the formation of cartilage masses and suggest a reasonable explanation of the frequent occurrence of sclerotic bone in the antefenestral area. Assumedly, in the latter instance, the cartilage is not slowly converted into intrachondral and endochondral bone but is displaced by a vascular, gnarly bone whose growth occurs at the expense of original capsular architecture. The ultimate formation of sclerotic bone would seem to represent the next stage in the same continuous process of histologic maturation and replacement. Were this new bone to spread by exuberant growth beyond its site of origin, it may come to involve anatomically important elements in the auditory apparatus; impingement upon, and immobilization of, the stapes may then be manifested as clinical otosclerosis.

Anson, B. J., and Cauldwell, E. W. The Normal and Pathologic Structure of the Fissular Region of the Temporal Bone, *Ann. Otol. Rhin. & Laryng.* **55:** 700, 1946.

The authors suggest that there may be some correlation between otosclerosis and a peculiar structure of the fissula which is observed only in man. For complete details of the development of the fissula, see the original article.

Antolí Candela, F., and Antolí Candela, F. Surgical Treatment of Otosclerosis, *Bol. Inst. pat. med.* **4:** 153, 1949.

This is a discussion of results.

Aubin and Clerc. Some Details of the Technique of Fenestration, *Ann. oto-laryng.* **65:** 551, 1948.

The authors use the direct atticotomy as described by Oubry. When the fistula is created, the periosteal bone must be removed in a wide area around the fistula. Careful hemostasis is essential. The actual window is created with one stroke of the burr; then the bone chips are aspirated with one suction.

Berendes, J. Advances in Operative Techniques in Otosclerosis, *Med. Monatsschr.* **3:** 86, 1949.

Beretta, L. The External and Middle Ear in Otosclerosis, *Arch. ital. otol.* **59:** 238, 1948.

Two hundred patients with otosclerosis were examined for signs in the external and middle ears described by other authors as concomitant.

Bernardini, A. Progressive Deafness and Otosclerosis in Children, *Ann. oto-laryng.* **65:** 159, 1948.

The author believes that progressive deafness in children as described by Citelli only simulates otosclerosis. The true otosclerosis begins at the age of 15 or 16 with vascular disturbance and a period of osteoclasis, followed by osteogenesis. In the progressive deafness among the children under consideration, the final stage is seen between 5 and 7 yr. of age and may be alleviated by iodine treatment, which

has no effect on otosclerosis. An opinion is expressed that the infection may be of syphilitic origin and hereditary, in spite of the fact that no other manifestations of syphilis were observed.

Blondiau, J. Indications for the Surgical Treatment of Otosclerosis, *Scalpel* **101:** 295, 1948.

This is a critical discussion of the indications for the fenestration operation.

Bordes Valls, M. New Neurosurgical Route for the Treatment of Otosclerosis, *Rev. españ. oto-neuro-oftal. y neurocir.* **7:** 65, 1948.

A new approach to the middle ear and labyrinth for the fenestration operation is described. It consists in incising through the skin and the temporal muscle upward and perpendicular to the zygomatic arch and through the temporal squama; the dura mater is separated, and the top of the tympanic cavity is perforated with an electric drill. The incus is removed, and the remainder of the operation follows Lempert's technique. The author's technique is believed to have the following advantages: (*a*) simplicity of anesthesia; (*b*) impossibility of injuring the facial nerve; (*c*) immediate healing of the wound; (*d*) avoidance of tamponade and of postoperative treatment; (*e*) avoidance of visible cicatrix, and (*f*) shortening of the time of operation.

Bouche, J. Surgery of Deafness: Its Limits and Results, *Bull. méd.* **63:** 123, 1949.

Of 100 patients operated upon a year or more previously, 42 showed very good results, 18 partial improvement, 32 rapid failure, and 8 secondary failure, all due to the closing-in of the bone. Of 50 patients operated upon six months or more previously, good results were obtained in 30, partial improvement in 7, immediate failure in 8, and secondary failure in 3. In these cases, therefore, 74% of the patients had experienced varying degrees of improvement in their hearing. In 8 there was a transient facial paralysis, vertigo lasting six months, stenosis of the duct, or persistent discharge.

Brunner, H. Otosclerosis Associated with Osteoporosis and Labyrinthitis Chronica Ossificans, *Arch. Otolaryng.* **49:** 184 (Feb.) 1949.

A case is reported of a diffuse otosclerosis in both temporal bones in a man dying of pleural empyema. The diffuse lesions were combined with foci of osteoporosis involving the annulus, the ossicles, and the capsule of the cochlea.

Brunner, H. The Healing of Labyrinthine Fistulae, *Acta oto-laryng.* **35:** 352, 1947.

The healing of artificial fistulas in the semicircular canals is similar to the healing process in bony fractures. The space is first filled with connective tissue, and this is later replaced by bone built up by the osteoblasts. If the new connective tissue is hyperplastic, it can extend into the semicircular canal and later cause a bony growth therein. Three well-studied cases of cholesteatomatous fistulas are reported. It was found that the bony regeneration was quite similar to that observed in cases of artificial fenestra formation in animals. To prevent the closing of the fenestra, a sterile technique is of the utmost importance because the most potent factor in regeneration of the connective tissue is infection. Thermal irradiation or

radium applications to the rim of the fenestra produced no results because osteoblasts played no part in the formation of the connective tissue; covering the fenestra with epithelium was also ineffective. The fistula was covered with a cholesteatoma matrix; nevertheless it showed an overgrowth of connective tissue. The same results were obtained when metal plates were used. It is necessary to apply the material with which we expect to prevent osteogenesis not on but into the fenestra. The author uses a Thiersch graft taken from the posterior surface of the pinna.

Calvet, J., and Claux, J. Treatment of Otosclerosis by Fenestration Operation, *Toulouse méd.* **49:** 336, 1948.

Sourdille's and Lempert's methods are described and two cases reported.

Campbell, E. H. An Analysis of Results Obtained in the Labyrinth Fenestration, Operation for Otosclerosis with Report of 100 Cases, *Tr. Am. Otol. Soc.* **36:** 90, 1948.

The author believes that if there is less than a 35 db. loss the patient should not be subjected to the fenestration operation. Patients in whom a 25 to 30 db. improvement is not sufficient to bring the hearing up to a practical level and who have a loss of bone conduction for the 1024 and 2048 frequencies of less than 25 db. are considered to have a fair prognosis as to improvement. The author reports 72 cases with ideal operative indications, showing a successful outcome in 72.2%, and 20 cases with less ideal operative indications, showing success in 50%. In the entire group there were 23 cases of failure, in which partial or complete closure was presumed to have occurred in 14; among four cases with revision there were two successes.

Campbell, E. H. The Effectiveness of Dramamine in Relieving the Vestibular Reactions Following the Labyrinthine Fenestration Operation, *Laryngoscope* **59:** 1261, 1949.

Dramamine® (dimenhydrinate) in 100 mg. tablets was given after the operation in 28 cases, six tablets on the first and second days following the operation, and on the third day only if the vertigo had not satisfactorily diminished. The results were as follows: marked relief in 8; considerable relief in 9; moderate relief in 11. Untreated patients required approximately two days longer to return to a normal diet than was required by those treated with dramamine.®

Campbell, E. H., and Macfarlan, D. Test Findings Before and After Fenestration of the Labyrinth, *Arch. Otolaryng.* **47:** 590 (May) 1948.

The tests for determining suitability of cases for the fenestration operation are set forth. No definite correlation between the speech and pure-tone hearing improvements obtained by the fenestration operation were discovered. After the operation the nystagmus was almost invariably directed to the nonfenestrated side, and the majority of the patients showed an active response to the fistula test with the various techniques. Good hearing may result even in the absence of a positive fistula response, and there may be no improvement in hearing in the presence of a positive fistula response. Adequate explanations are not available at this time.

Cawthorne, T. Review of Surgery of Otosclerosis, *J. Laryng. & Otol.* **62:** 100, 1948.

Chausse, C. P. Incidence III and the Surgical Treatment of Deafness, *Acta oto-rhino-laryng. belg.* **3:** 513, 1949.

The suitability of incidence III for roentgen visualization of the external auditory canal, the oval window, and the basal coil is discussed.

Constas, N. P., and Camessas, T. The Main Causes of Unsatisfactory Results of the Lempert Fenestration Operation for the Surgical Treatment of Clinical Otosclerosis, *Proc. Greek E.N.T. Soc.*, 1949.

The presence of otosclerotic tissue in the region of the round window is believed to be one of the main causes of unsatisfactory results following the Lempert fenestration operation, and it is obviously impossible to diagnose the localization of these lesions preoperatively. When, during the operation, such a lesion in the round window is observable by the otomicroscope, it is suggested that a new round window be made, either between the subiculum promontorii and the cecum vestibuli or by opening the round window to remove the impedance. The authors have not as yet undertaken such an operation on living subjects.

Cornelli, G. Technique and Results of Opening up of the Labyrinthine Vestibule Through the Fenestra Ovalis in the Treatment of Otosclerosis, *Osp. maggiore,* **37:** 55, 1949.

This method is based upon opening up the fenestra ovalis. The stapes is removed and the oval window then opened and later protected by adhesions which form between the edge of the drum membrane and the inner wall of the tympanic cavity. Forty patients were operated upon by this procedure and several observed for over a year. It is claimed that the method is much less injurious than is the making of a fistula in the semicircular canal.

Day, K. M. Medical and Surgical Care of the Patient Selected for Fenestration of the Labyrinth, *Tr. Am. Otol. Soc.* **37:** 197, 1949.

Three primary causes of failure of the fenestration operation are (1) faulty diagnosis and selection of cases; (2) postoperative fibrosis in the vestibule resulting from hemorrhage, entrance of foreign material, or damage to the vestibule, and (3) closure of the fenestra. Nasal allergy is believed to be partially responsible for some of the failures, as is faulty postoperative care of the wound. Premature discharge may lead to the acquisition of secondary infection, which may persist.

Delstanche, J. P. Fresh Details of Fenestration Operation, *Acta oto-rhino-laryng. belg.* **1:** 326, 1947.

Dias Martins Pereira, F. Fenestration of the Labyrinth in the Treatment of Deafness Due to Otosclerosis, *Rev. clin. espan.* **30:** 184, 1948.

It is important to secure correlation of the results obtained by acoumetry, tuning forks, and the audiometer. A suitable candidate for fenestration must hear the 256 fork for 12 sec. longer by bone conduction than by air conduction, the 512 fork

for 6 sec. longer, and the 1024 fork for 4 sec. longer. As the auditory improvement obtainable by fenestration is about 20 db. and seldom 30 db., the possible benefits will be inadequate for hearing ordinary conversation, unless the hearing loss is less than 60 db. or more than 40 db. by air conduction. The loss by bone conduction should not exceed 10 db. Three groups are distinguished according to their availability for fenestration. The percentages regaining useful hearing and those not gaining it are set forth. In some of the patients with the poor prognosis there may be a decrease in the intensity of the tinnitus, but these persons should not be operated upon.

Dias Martins Pereira, F. Lempert's Technique for Fenestration of the Labyrinth: Improvements Introduced by Shambaugh, *Rev. clín. espan.* **30:** 188, 1948.

Dieter, H. Technique of the Otosclerosis Operation, Lempert-Holmgren, *Ztschr. Hals- usw. Heilk.* **1:** 186, 1948.

This is a review of the problem.

Dieter, H. Technique of the Otosclerosis Operation, *Ztschr. Laryng. Rhin. Otol.* **1**[27]**:** 231, 1948.

This is a review of the problem.

Dokkum, A. J. H. Endaural Surgery and Fenestration Operation, *Nederl. tijdschr. geneesk.* **92:**474, 1948.

The author presents a discussion of the indications for and the technique of what he calls "the conservative radical and complete radical endaural mastoidectomy." The speech test of Walsh and Silverman is recommended for diagnosis and evaluation of the functioning of the cochlea both before and after the operation.

Drymael, A. The Technique of Gellé's Test, *Acta oto-rhino-laryng. belg.* **2:** 22, 1948.

The author's technique uses manometer determinations of the pressure and tones of different pitch and intensity. He states that frequencies above 1024 cps cannot be suppressed by 5 to 15 mm. of mercury. There is a limit of intensity above which the tone cannot be suppressed even when the contralateral bone conduction is excluded.

Ewertsen, H. Acoustic Function Before and After Operation for Otosclerosis, *Arch. Otolaryng.* **49:** 393 (April) 1949.

The author reviews the fallacies of subjective hearing tests and presents a statistical survey of the hearing before and after operation in 85 patients. The air conduction of 30 patients given Fowler's test was plotted graphically. Bone conduction remained better than air conduction in 12 of the 19 patients in whom it was employed. These figures were compared with the figures obtained from leading clinics. The criterion of no more than a 30-db. loss by bone conduction in the speech range was fulfilled in only one instance. Depression of the upper tone limit appeared to have bad prognostic significance in these cases.

This article is part of a group study. Other articles were by Lund, Rasmussen, Riskaer, and Selsø.

Facchini, G. B. Fenestration of the Labyrinth: Short Report on the Convention of Strasbourg, *Bull. sc. med.* **120:** 379, 1948.

Farrior, J. B. The Fenestration Operation: Analysis of Results, *New Orleans M. & S. J.* **101:** 169, 1948.

Farrior, J. B. The Fenestration Operation: Indications, Technique and Results, *Laryngoscope* **59:** 515, 1949.

The author makes a tympanomeatal flap before any bone surgery is undertaken. This allows him to control all the bleeding before the labyrinth is opened. The flap is covered with a protective layer of surgical rayon, and the mastoid antrum is opened through the external auditory meatus. The operation is completed by grafting with "split-thickness skin," and this, with the tympanomeatal flap, is held in position with surgical rayon and synthetic sponge packing for several days.

Femenic, B. A View on the Surgical Treatment of Clinical Otosclerosis, *Zbornik radova otorinolaringoloske klinike u zagrebu, Izdavacki zavod jugoslavenske akademije znanosti i umjetnosti,* 1948, p. 147.

Fernando, A. S., and Bongco, F. T. Blue Scleras with Otosclerosis: Case Reports, *J. med., Pôrto* **12:** 525, 1948.

Fowler, E. P. Calcium and Phosphorus, and Phosphatase Activity, in Otosclerosis, *Arch. Otolaryng.* **47:** 491 (April) 1948.

The author discusses the alternating periods of activity and quiescence in otosclerosis in correlation with different decades of life. So far as activity is reflected in blood changes, few impressive correlations have been obtained. Evidently a modification of the approach to the problem is needed. This paper should be read in detail. The summary follows:

The blood serum calcium, phosphorus and phosphatase determinations reported here indicate that phosphorus (inorganic phosphate) was below 3.5 mg. per hundred cubic centimeters (the low normal limit) in 62 per cent of the women and 56 per cent of the men. The calcium also was definitely on the low side, being below 9.5 mg. per hundred cubic centimeters in 70 per cent (66 per cent of the women and 80 per cent of the men). The phosphorus was below 3.5 mg. in two thirds of those with calcium below 9.5 mg., and the calcium was below 9.5 mg. in over two thirds of those with phosphorus below 3.5 mg. The percentage of patients in which association of low calcium and low phosphorus occurred has not heretofore been demonstrated in studies of otosclerosis.

The phosphatase activity was within normal limits except in a few of those with low calcium. The possible significance of such findings is discussed.

It would appear that the important implication of these blood chemistry determinations is that intake and utilization of calcium and phosphorus should be carefully studied and controlled, especially during those periods of life when an ample supply is necessary for the good health of the body as a whole, and particularly in those cases in which there is a family history of otosclerosis, with a view to insuring the maximum required for health of the bone containing the inner ear. In view of the findings it would be folly to neglect this in spite of the meagerness of knowledge of the causes of the lesions of otosclerosis or of the causes of their activity.

Fowler, E. P. Estrogen, Bone Metabolism and Otosclerosis, *Arch. Otolaryng.* **48:** 637 (Dec.) 1948.

The author tentatively suggests an explanation which involves the sex hormones, and particularly estrogens, to account for certain sex-linked episodes frequently coinciding with the onset of, or an increase in, the deafness caused by otosclerosis.

Several metabolic and endocrine disorders of bone which may involve the otic capsule in several respects resemble the lesion of otosclerosis (Paget's disease, von Recklinghausen's disease, and so-called low-calcium rickets in animals). However, these diseases show distinctive morphologic features which permit their differentiation. Osteosclerosis almost invariably begins during periods of growth and is frequently accompanied with dental caries. It is associated with recessive traits. Like osteosclerosis, otosclerosis is a familial disorder of bone, but it is a dominant trait. Osteogenesis imperfecta, like otosclerosis, is frequently associated with blue scleras and appears to be due to congenital deficiencies in the mesenchymal tissues of the body.

Estrogens are intimately connected with bone metabolism in many animals. The fluctuations in estrogens are greater in women at puberty, pregnancy, and the menopause, and the differences in skeletal growth between men and women may be related to a greater quantity of estrogens in women than in men. It is pointed out also that the estrogens are intimately connected with the stability of the autonomic nervous system, and that patients deafened from otosclerosis are emotionally hypersensitive, more so than patients with other types of impedance deafness.

The capillary beds are affected by emotional factors and the estrogens. The races which have more stable sympathetic nervous systems have fewer bone dyscrasias and a lower incidence of otosclerosis and are less prone to pyloric spasms.

It is believed that estrogens are so closely associated with the calcium and bone metabolism and the autonomic nervous system that it is permissible to assign to them a role in the etiology of otosclerosis, at least in persons with a receptive hereditary background. Because deafness from otosclerosis sometimes begins and frequently progresses shortly after the menopause, it has been inferred that otosclerosis frequently begins after the menopause.

The author states that he has never observed otosclerotic deafness (stationary or increasing) immediately following the menopause, unless it had been present before the menopause, an observation which fits in with the fact that the incidence of otosclerosis, the activity in the lesion, and the proportion of small lesions all decline after the menopause. Guild's data and clinical observations support these views.

Fowler, E. P. Nonvibratory Tinnitus: Factors Underlying Subaudible and Audible Irritations, *Arch. Otolaryng.* **47:** 29 (Jan.) 1948.

The author subdivides tinnitus into two types, vibratory, which is caused by actual autogenous vibrations reaching the ear from any part of the body, and nonvibratory, caused by biological irritation of the auditory neural mechanism. Many cases of tinnitus are enumerated, but the author stresses the role of anoxia caused by circulatory deficiencies. He believes that when a nonvibratory tinnitus subsides the lesions causing it have not necessarily disappeared entirely. They may be insufficient to permit the tinnitus to reach threshold by slight accentuation. In other

words, tinnitus may be audible or subaudible. The author stresses the fact that there is no sure cure for tinnitus, and he believes that a careful history is of the utmost importance. He measures the frequency and intensity of the tinnitus according to the methods he has discussed previously. A complete otological and physical examination is made. There is no one drug or surgical method for the cure of tinnitus because the etiological basis is too varied. The treatment must be aimed to subdue any possible cause, and the cause of the deafness must not be neglected. Never tell a patient that nothing can be done for tinnitus, even the tinnitus due to otosclerosis, because if you do this you will do more than just nothing, you will do him positive harm.

Fowler, E. P. The Incidence (and Degrees) of Blue Scleras in Otosclerosis and Other Ear Disorders, *Laryngoscope* **59:** 406, 1949.

Blue scleras are observed to occur twice as often in women as in men. Their cause is unknown. The depth of the blueness is influenced by neurovascular changes and is especially associated with emotional disturbances. The author reports observations on 568 patients. Blue scleras were found in 69% of those with otosclerosis and in 10% of the controls with normal hearing (6% males; 15% females), percentages which closely coincide with Guild's autopsy ratios for the incidence of otosclerotic foci in temporal bones (6% in males; 12% in females). The incidence of otosclerosis was highest in proportion to the blueness of the scleras. In only 3% of those with the white scleras was the disorder diagnosable as otosclerosis, whereas 100% of those with 4 + blue scleras had otosclerosis. The data may indicate that there is some etiological factor common to blue scleras and otosclerosis, but the rare occurrence of osteogenesis imperfecta in persons with otosclerosis suggests that there is apparently no close relationship between these two diseases.

Fugère, P. Otosclerosis, Deafness, and Fenestration, *Laval méd.* **13:** 450, 1948.

The author discusses the fenestration operation and the possibility of first and second pregnancies aggravating the deafness. He considers that increases in the deafness in otosclerosis are due to degeneration of the auditory nerve, but no evidence is set forth in substantiation of this statement. The recruitment phenomenon is described as a method for distinguishing between conduction and perception deafness. He states that the pink tinge on the promontory is rare.

Fugère, P. Deafness and Fenestration, *Union méd. Canada* **77:** 485, 1948.

The problem is reviewed.

Fumagallo Pérez, L. Trepanation of the Mastoid Through the Auditory Canal, *Arch. méd. mex.* **6:** 406, 1948.

García Ibáñez, L. The Present Status of Surgery of the Ear: Impressions of a Visit to the United States, *Rev. españ. oto-neuro-oftal. y neurocir.* **6:** 281, 1947.

The author reviews the present status of the surgical treatment of deafness in the United States. Among other conclusions are these: Permanent results are

obtained in 60% of the patients on the basis of a return of practical hearing; in 89%, definite improvements may be obtained; facial paralysis occurred only once in 150 patients who underwent surgery for this defect; postoperative closure of the fenestration has been reduced to 5% and serous labyrinthitis to 1%.

Germán, T. Serous Labyrinthitis as a Failure in Fenestration, *Acta oto-laryng.* **36:** 220, 1948.

Postoperative absence of the caloric stimulus indicates a subsided irreparable serous labyrinthitis, even if a positive fistula sign is still present. The use of weak stimuli according to the method of Veit, and as modified by the author, is believed to be the best means of determining the degree of the labyrinthitis.

Gordon, C. H. The Fenestration Operation, *Brit. M. J.* **1:** 906, 1948.

This is a letter to the editor.

Gray, O. New Method of Demonstrating the Labyrinth Together with Those Related Structures Which Lie Within the Petrous Portion of the Temporal Bone, *J. Laryng. & Otol.* **62:** 308, 1948.

Guns, P. Otosclerosis: Fenestration Operation; Personal Cases, *Belg. tijdschr. geneesk.* **4:** 1019, 1948.

Of 11 patients examined after operation, six recovered "practical hearing" for a period of one and a half years.

Gutteridge, E. Linear Fenestration of Lateral Semicircular Canal Using Curets and Dental Excavators, *Arch. Otolaryng.* **50:** 833 (Dec.) 1949.

Ash dental excavators are employed. When the endosteum is exposed, it is removed by needling and irrigation.

Gutteridge, E. Fenestration, *Australian & New Zealand J. Surg.* **19:** 75, 1949.

Gutteridge presents a summary of the results obtained in 107 cases.

Guttich, A. A Fistula Symptom in the Absence of Fistula, *Arch. Ohren- Nasen-Kehlkopfh.* **155:** 15, 1947.

Pneumatic pressure caused a nystagmus toward the affected side in several patients with major perforations of the drum membrane. This reaction is ascribed to an increase in temperature due to compression of the air, which rises 1 to 2 degrees C. during the procedure.

Hall, I. S. The Operative Treatment of Nonsuppurative Middle Ear Deafness, *Edinburgh M. J.* **54:** 167, 1947.

Hall, I. S. On the Technique of the Fenestration, *J. Laryng. & Otol.* **63:** 382, 1949.

The author uses a postauricular incision extending above the external auditory meatus. This is deepened to expose the sheath of the temporal muscle, which is split without dividing the muscle fibers. The auricle is thus adequately mobilized and can be pulled forward sufficiently to overcome the criticisms aimed at the post-auricular incision. A plastic flap is fashioned at the beginning of the operation,

as advocated by Popper in his transtympanic approach. Removing this flap from the bone is safer than removing the bone from the flap. The "dome" is ground down with a diamond burr, and the facial canal is kept in view throughout the maneuver. After the lumen of the vestibule has been clearly defined, the "dome" is uncapped.

Hamberger, C. A. Fenestration Operation for Chronic Adhesive Otitis, *Nord. med.* **38:** 1256, 1948.

The differential diagnosis of otosclerosis from chronic adhesive otitis media is difficult, if not impossible. In two cases with chronic adhesive otitis, one with a large central perforation, the fenestration operation appeared to improve the hearing.

Hamberger, C. A., and Hydén, H. Cytochemical Studies on Experimental Bone Fistulae, *Acta oto-laryng.* **35:** 479, 1947.

This is a report upon the first of a series of investigations on the prevention of bone regeneration in fistulas experimentally produced. In 200 experimental fistulas in 76 guinea pigs, bone formation was studied by cytological and cytochemical methods. From the latter it was deduced that osteoblasts take part in the production of osteogenic tissues rich in protein. Colchicine and sodium cacodylate were used to prevent the first phase of bone regeneration, i. e., the differentiation of the osteoblasts. These antimitotics delayed and disorganized the development of the osteoblasts by injuring the nuclear structures, and they interfered also with the formation of proteins in the cytoplasm. They did not prevent regeneration but appeared to delay the process for as much as double the normal time.

Harty, M. Some Anatomical Points in the Fenestration Operation, *J. Laryng. & Otol.* **62:** 36, 1948.

The construction and fitting of the flap used in the fenestration may be simplified by keeping in mind certain points in the anatomy. The skin of the meatus is adherent anterosuperiorly at the point where the tympanic plate projects below the squama, but it is easily separated at the notch of Rivinus. If the arteries to the flap which run in the two malleolar folds are small in caliber, they may cause an ischemic necrosis with undue manipulation and mobilization of the flap. The membranous semicircular canal is attached along its convexity to the bony canal. In order to enter the perilymph space between the two, one should make the fenestra anteriorly.

Herberts, G. The Development in Surgical Treatment of Otosclerosis and a New Method of Operation, *Upsala läkaref. förh* **53:** 287, 1948.

The author presents a survey of the literature to date. Operative treatment is directed mainly to the ankylosis of the stapes footplate. The membrane covering the base of the stapes must be preserved, and in otosclerosis this is not difficult because it is not so thin and fragile as the normal membrane. In two cases the author used the endaural approach, extirpated the incus, and made the classic flap. He found the otosclerotic foci to form a bridge in front of and below the fenestra rotunda. The inferior and the posterior margins of the stapes footplate are separated from the fenestra rotunda. With special techniques the author removes

the stapes plate and leaves behind and preserves the membrane of the fenestra. At the moment of removal there is a nystagmus to the treated side, vertigo, and an improvement in hearing. The membranomeatal flap is replaced.

Hicguet, M. C., and van Eyck, M. Operative Results in a Series of 50 Fenestrations, *Ann. oto-laryng.* **65:** 552, 1948.

An endaural technique, with direct approach to the attic without opening the antrum, is used. Under constant irrigation the horizontal and the vertical canals are opened. The superior cervical ganglion is anesthetized with procaine (novocain®) hydrochloride in order to reduce the serous labyrinthitis. This technique gave good results in 82% of the series.

Hicguet, M. C., and van Eyck, M. Problems Arising in the Postoperative Course of Fenestration Patients, *Rev. laryng.* **69:** 301, 1948.

The authors do not hold with the general opinion that the contralateral nystagmus and the decrease in hearing observed postoperatively, which usually become more apparent after two to three days, are due to serous labyrinthitis. They believe the hearing loss is due to the serous labyrinthitis but that the nystagmus which occurs immediately after the opening of the perilymphatic space is caused by an imbalance in the perilymph and endolymph systems. For the serous labyrinthitis 10 ml. of a 10% saline solution is administered twice daily for three days, and the superior cervical ganglion is anesthetized with 1% procaine hydrochloride solution. They describe the hearing gain as possibly due to an activation of bilateral reflexes caused by the impact of the sound on the tensor tympani and to the crossing of the aural pathways in the brain. In 48 of the patients there were a negative fistula sign and a maintenance of practical hearing. No apparent difference was noted in the sound patterns obtained through the normal stapedial system and that obtained through firm adhesions of the membranous labyrinth and the flap.

Hicguet, M. C. Surgery of Deafness: Technique of Hicguet and van Eyck, *Bruxelles-méd.* **29:** 3602, 1949.

Hochfeld, M. Medical Treatment of Otosclerosis, *France méd.* **12:** 12, 1949.

Holmgren, G. Surgical Treatment of Otosclerosis, *Nord. med.* **37:** 151, 1948.

This is a review of the history of the fenestration operation for otosclerosis and a brief account of the author's results with Lempert's modifications thereof. The author has obtained good results in 90% of his cases immediately following his operation, but he cannot predict the final results.

Holmgren, G. Fenestration: 2 Interesting Cases, *Acta oto-laryng.*, supp. 67, p. 28, 1948.

In one case, that of a 12-yr.-old girl, a conduction deafness had existed since birth, but the diagnosis was uncertain; the results of the fenestration operation were remarkably favorable. In the other case, that of a 39-yr.-old man, there was complicating neurogenic deafness above 3000 d.v.; the result of operation was good.

Holmgren, G. A Case of Otosclerosis, *Pract. oto-rhino-laryng* **10:** 230, 1948.

A patient with typical otosclerosis without nerve-deafness, operated upon in 1938 by fenestration of the posterovertical semicircular canal, showed improvement for three weeks and then a loss to the former state. Subsequent operation by Lempert's technique did not produce even a primary improvement in hearing. The closing of the fenestra rotunda between the two operations is suggested as a cause for the failure of response to the second operation.

Holmgren, G. Present-Day Surgery of Otosclerosis, *Acta oto-laryng.*, supp. 74, p. 19, 1948.

The location of the fistula over the vestibulum is most important, as in this location it can be made larger than anywhere else and, moreover, here it may be covered with the thinnest possible layer from the external auditory canal. The bone-conduction curve is not a reliable criterion for operation. The author considers a good operational result preferable to use of a hearing aid. All patients should be fully informed of the possibilities of the operation and the risks involved.

Holmgren, G. To the Development of Otosclerosis Surgery, *Acta oto-laryng.* **37:** 26, 1949.

The author describes a recent development in his postauricular technique. The mucoperiosteal flap made from the inner wall of the aditus and hinged on the facial canal is placed over a dome fenestra which is ground so as eventually to consist of the thinnest possible sheet of endosteum. This thin endosteum is not removed. The attic is packed with subcutaneous fat and the wound closed.

House, H. P. The Fenestration Operation, *Ann. Otol. Rhin. & Laryng.* **57:** 41, 1948.

House reports on his first 500 cases and the techniques employed. A dry field and avoidance of heat from the burr are stressed and a method for maintaining an intact endosteum is presented. If the Rinne reaction is negative at 1000 d.v. it is assumed that the case is suitable for operation. A very low incidence of facial paralysis and of vertigo was observed. In 20% of the patients there was an annoying postoperative discharge in the ear. "Serviceable hearing" was maintained in 60% of the patients after one year, and in only 4% was the hearing diminished. In 12% of the patients the fistula closed but in no instance after one year. Tinnitus was abolished in 24% and partially removed in 54%.

Huizing, H. G. The Relation Between Auditory Fatigue and Recruitment, *Acta oto-laryng.*, supp. 78, p. 169, 1949.

After an ear is subjected to a fatiguing tone or sound, its threshold is raised. In perception deafness when a fatiguing tone of 2000 d.v. is applied for 3 min. at a level 30 db. above threshold, the change (elevation) in threshold is much greater than in normal ears. This phenomenon occurs because sounds of this intensity produce a much greater loudness in a perception-deafened than in a normal ear or than in an ear that is deafened by impedance. The result is that in the nerve-deafened ear the fatigue is much greater. The author measures this by experiments. He believes that a shift of the threshold up to 12 db. after three minutes'

exposure to a 30-db. level above threshold at 2000 d.v. should be considered as normal but that a greater shift indicates the presence of the recruitment phenomenon. He points out that this recruitment effect explains some of the difficulties encountered in the use of hearing aids. He offers this fatigue test as a variation of the tests introduced by Fowler. It is particularly useful when one ear is totally deaf or the hearing is equal binaurally.

Jannulis, G. E. Our Observations on Lempert's Operation in Otosclerosis, *Monatsschr. Ohrenh., Vienna* **82:** 270, 1948.

Jelnes, K. T. Osteogenesis Imperfecta with Otosclerosis, *Ugesk. læger* **111:** 1262, 1949.

The deafness in osteogenesis imperfecta is of the same type as in otosclerosis, and it is sometimes of mixed type, as occurred in a 40-yr.-old woman described in the text. Upon insistence, the fenestration operation was performed on the left side with a subsequent improvement of the hearing between 5 to 10 db. Some 25 to 30% of those afflicted are deaf; 55 to 60% have fragile bones, and about 95% have blue scleras.

Jent, R. The Surgical Treatment of Otosclerotic Deafness, *Schweiz. med. Wchnschr.* **78:** 772, 1948.

The author reports the results in 20 patients operated upon under local anesthesia. There is not much difference in the postoperative course of the cases with and without stopple. The hearing was completely restored for "social intercourse" in seven, partially restored in 11, and not improved in two of the patients. In no patient was there a postoperative deterioration in the hearing.

Johnson, C. L. Fenestration Surgery for Deafness, *New England J. Med.* **239:** 619, 1948.

Johnson, L. F., and Silva, H. Present-Day Status of Fenestration Surgery, *New England J. Med.* **240:** 718, 1949.

The results of fenestration surgery on 183 patients are reported.

Jones-Raymond, R. T. Clinical Otosclerosis: The Transtympanic Approach for the Restoration of Serviceable Hearing, *South African M. J.* **23:** 761, 1949.

Jones, M. F., and Edmonds, F. C., Jr. Acoustic and Vestibular Barometry: Air Pressure Effects on Hearing and Equilibrium of Unoperated and Fenestrated Ears, *Ann. Otol. Rhin. & Laryng.* **58:** 323, 1949.

This preliminary report describes several of the effects on hearing and equilibrium caused by an increase or decrease in air pressure on the middle and inner ear structures. Changes in the hearing threshold plus vertigo produced by variations in air pressure were studied in both untreated and fenestrated ears.

A simple apparatus was constructed, consisting of a water manometer, ear plugs, and a Western Electric 6BP audiometer with a modified air-conduction receiver. The water manometer registered ± 100 cm. of water pressure and was graduated in 2-cm. steps.

It was found that

the audiometric decibel intensity difference between bone conduction and air conduction is related to the variation in the bone conduction hearing at threshold produced by pressure change. A classification of impaired hearing by audiometry was developed based on the audiometric decibel intensity difference between bone conduction and air conduction thresholds. This classification is similar to the time differential used in testing hearing by tuning forks.

The conclusions were as follows:

Some of the effects of air pressure change on the hearing and equilibrium of 32 unoperated and 8 fenestrated ears were described.

The results emphasize the importance of the dampening function of the drum and ossicles in the low and middle frequencies. A functioning drum and ossicular chain is necessary to obtain changes in hearing due to altered air pressure.

The effects of changes in air pressure on bone conducted sound at 256 and 1024 cycles are in proportion to the magnitude of the audiometric decibel differential between the bone conduction and air conduction thresholds. A differential of 30 decibels is critical and may indicate stapes fixation.

In 8 fenestrated ears, there was a correlation between the hearing improvement and the vertigo resulting from air pressure change. There was no vertigo noted with air pressure change in the 32 unoperated ears.

Further study may establish the air pressure test as a test for stapes fixation in the unoperated ear and as a test for patency of the fenestra in the fenestrated ear.

Jongkees, L. B. W. Fenestration of the Labyrinth: Statistics on the Results of Operative Treatment in 100 Cases of Otosclerosis, *Nederl. tijdschr. geneesk.* **93:** 3547, 1949.

One hundred patients were operated on by the method of Passe with a long opening. In 4% the hearing was worse than before the operation. Those between 31 and 50 yr. of age appeared to obtain the best results. The incidence of closure of the fistula was highest in young persons.

Jongkees, L. B. W. Some Data on the Fenestration Operation: Its Risks and Side-Effects, *Nederl. tijdschr. geneesk.* **93:** 4078, 1949.

Jongkees reports on the results as to hearing, accidents, and complications at least a year after fenestration operation in 100 patients.

Jongkees, L. B. W. Risks and Sequels of Fenestration Operation, *Nederl. tijdschr. geneesk.* **93:** 4078, 1949.

Jongkees, L. B. W., and Hulk, J. Changes in Vestibular Reactions After the Fenestration Operation, *J. Laryng. & Otol.* **63:** 225, 1949.

The patients examined had been subjected to the Passe technique. Among those patients suitable for the fenestration operation, 30% had a sensation of disturbed equilibrium. Objectively, the reactions were within normal limits unless cupulograms were made. A nystagmus was observed, first heterolateral and then homolateral. This was not influenced by the position of the head. No abnormality was noted in the tilting reaction six days postoperatively. For a few, the caloric reactions were absent and, when this was the case, there was a directional preponderance toward the unoperated ear. Either objectively or subjectively there appeared to be no simple correlation in the improvement of hearing and the vestibular symptoms.

Jongkees, L. B. W. Evaluation of Results in Fenestration Operation for Otosclerosis, *Nederl. tijdschr. geneesk.* **93:** 4290, 1949.

The author discusses some of the differences between the subjective and the objective results after the fenestration operation. He observed that hearing in the contralateral ear had improved in 27 of 100 patients one year postoperatively, although in some of these patients there was no improvement in the hearing of the ear operated on. A 40-db. improvement in the frequency range 500 to 4000 d.v. was regarded as the border line on which to base a standard of improvement or no improvement. It must be assumed that in some instances the bone conduction was improved also. Factors that should be considered before operation are bone conduction, paracusis, and the progressiveness of the deafness. The author finds that the hearing in some patients appeared to improve even more than six months postoperatively.

Juers, A. L; Derlacki, E. L., and Shambaugh, G. E., Jr. Chronic Progressive Deafness, Including Otosclerosis and Diseases of the Inner Ear: Review of the Literature for 1946, *Arch. Otolaryng.* **50:** 97 (July) 1949.

Juers, A. L. Observations on Bone Conduction in Fenestration Cases, *Ann. Otol. Rhin. & Laryng.* **57:** 28, 1948.

The author reports that in 51 of 88 consecutive patients the Weber test reaction lateralized for a few days to the ear operated on. Controls showed that this was not due to the packing of the wound. When the Weber reaction shifted to the contralateral or untreated ear, there appeared to be less initial gain in the hearing. The administration of 200 ml. of 50% solution of sucrose and 50 ml. of sorbitol referred the Weber reaction back to the surgically treated ear. The author believes that sounds through the air reach the inner ear mainly by way of the fenestra and that the more laterally situated the fenestra is in relation to the window the greater will be the difference in phase. A Pohlman prosthesis, or an artificial drum membrane, may be used to increase the phase difference when the fenestra is sufficiently lateralized.

Juers, A. L., and Shambaugh, G. E., Jr. Indications for and End Results of Fenestration Surgery, *Ann. Otol. Rhin. & Laryng.* **57:** 397, 1948.

The authors classify patients suitable for operation into three groups: (*a*) those in whom the cochlear function, as determined by bone conduction, showed no loss greater than 30 db. for frequencies of 500, 1000, and 2000, a negative Rinne reaction for 1000 and the lower frequencies, and normal or prolonged Schwabach reaction; (*b*) those who show bone-conduction loss for only one of the frequencies, usually 2000, of more than 30 db., with fork tests similar to those in (*a*), except that at 1000 air conduction and bone conduction may be equal and at 2000 the Schwabach reaction may show a greater loss; (*c*) those in whom bone-conduction loss is more than 30 db. usually for the two or three frequencies most useful for speech, with the Rinne reaction usually positive for frequencies of 1000, and the Schwabach reaction shortened for both 1000 and 2000. Approximately 75 to 80% of the patients in class *a* may be expected to obtain a hearing level equal to or better than

that obtainable by use of a hearing aid; class *b* patients have a 40 to 60% chance of obtaining good results, and class *c* patients have only a 10 to 20% chance. Class *c* and some of class *b* who wear hearing aids should be advised against surgical treatment. Two-year follow-up studies indicate that complete closure of the fenestra occurred in 1.4% in patients who had obtained a level of 35 db. or better at the time of their best postoperative hearing.

Juers, A. L., and Shambaugh, G. E., Jr. The Evolution of the Northwestern University Fenestration Technic, *Quart. Bull. Northwestern Univ. M. School* **23:** 56, 1949.

The authors present a statistical study of patients operated on by the new technique for the year ending November, 1946, and on whom tests were obtainable one year postoperatively.

Kelemen, G. Fenestration of the Labyrinth: A Bibliography, *Laryngoscope* **58:** 74, 1948.

Kettel, K. Cases of Otosclerosis Operated upon According to Lempert's New Method, *Nord. med.* **38:** 1042, 1948.

Kettel, K. Surgical Treatment of Otosclerosis, *Ugesk. læger* **110:** 243, 1948.

The results of surgical treatment of otosclerosis as presented in some of the published reports of different operators are given.

Kobrak, F. Study on Pathophysiological Factors in Clinical Otosclerosis, *Pract. oto-rhino-laryng.* **10:** 423, 1948.

The author mentions intracochlear and intravestibular pressure change as an etiological factor in otosclerosis and separates it into two categories: (1) stapedial pressure caused by spastic tympanic muscular contractions and (2) intralabyrinthine hydrops. The meaning and value of vestibular tests in clinical otosclerosis are described. In patients showing a normal or increased excitability of the labyrinth, the prognosis is better. Clinical otosclerosis is divided into four forms:

1. Classic otosclerosis. This condition may remain classic for an indefinite period but at any time may change and become type 3 or 4. The author believes that in this type there may be not only osseous stapes ankylosis but also nonosseous muscular spastic stapes fixation. 2. High-pitch otosclerotic deafness. The audiogram shows a high-tone deafness by air conduction and also frequently by bone conduction. 3. Dip-type cochlear otosclerosis. Dips appear in the air-conduction audiogram, especially at 1024 and 4096 d.v. 4. Spreading cochlear otosclerosis: (*a*) rapid-spreading juvenile type; (*b*) insidiously spreading old cases. Type 4*a* appears to be much more frequently associated with sub-normal vestibular excitability than any other type.

Procedures for differentiating between suitable and unsuitable cases for operation are (1) tenotomy of tensor tympani (possibly also of stapedius), and, if hearing fails to improve, (2) extensive lumbar or occipital puncture. If hearing improves after this step, a fenestration operation is indicated.

Kobrak, F. Extensive Lumbar Puncture as a Test of Differentiation Between Reversibility and Irreversibility by Labyrinthine Fenestration of Otosclerotic Deafness, *J. Laryng. & Otol.* **62:** 395, 1948.

The intricacy of labyrinthine fenestration consists not only of the delicacy of surgical technique, but perhaps even more of the difficulty in the proper choice of suitable cases. Often it seems to be not easy to say, how much the barred entrance of the sound waves to the inner ear, how far intra-labyrinthine changes are the source of deafness. If, apart from the sound conductive obstacle at the oval window, only abnormal intralabyrinthine pressure is the cause of high pitch deafness, and not yet degenerative changes in the organ of Corti, improvement of high pitch deafness can be expected from labyrinthine decompression: from the extensive lumbar puncture, and then also from labyrinthine fenestration. If, however, definite improvement of high pitch deafness fails to occur following extensive lumbar puncture, the prognosis can be regarded as doubtful indeed; in this case, the effect of fenestration is expected to be unsatisfactory by bringing about a more or less irrelevant improvement of only low pitch deafness and not of the pertinent high pitches of speech and conversational voice.

A further differential diagnostic outlook seems to emerge, as we obviously depend not only on auditory tests in our indication of labyrinthine fenestration. Also the behaviour of *vestibular* tests, especially on *minimal calorisation*, provides functional features which are probably of avail in the indication of labyrinthine fenestration.

This preliminary suggestion of a test by extensive lumbar puncture, based on possibly specific functional—auditory and vestibular—differences before and after the L.p. [lumbar puncture] test will be more fully discussed, soon, in a paper on clinical otosclerosis with special reference to abnormal intralabyrinthine pressure.

Kobrak, F. Clinical Contributions to Functional Otology: I. The Posterior Portion of the Ear as a Comprehensive Concept and Latent Subjective Vertigo as the Chief Manifestation of the Unity of the Function of the Inner Ear, *Ztschr. Laryng. Rhin. Otol.* **28:** 68, 1949.

The author thinks that the usual concept of the ear as being divided into a cochlear and a vestibular system should be abandoned. The ear functionally should be considered a single unit. In otosclerosis significance is attached to vestibular hypoexcitability, and this sign is assumed to represent increased intralabyrinthine pressure and to indicate a necessity for fenestration operation. Tests for the functioning of the inner ear muscles are discussed, and a negative Rinne reaction may be attributed in part to spasms of the muscles in otosclerosis and in cochlear deafness.

Koch, J. Reflections on the Therapy of Otosclerosis, *Ztschr. Laryng. Rhin. Otol.* **28:** 185, 1949.

Treatment with A.T. 10 (dihydrotachysterol) appeared to relieve a hearing loss due to otosclerosis which occurred during pregnancy. The author suggests that maybe the activities of the ovaries could be temporarily diminished by irradiation in persons with otosclerosis who have losses of hearing during the menstrual periods.

Kós, J. Surgical Treatment of Otosclerosis, *Rev. brasil. oto-rino-laring.* **16:** 73, 1948.

Kristensen, H. K. Some Cases Thought to be Familial Labyrinthine Deafness, *Acta oto-laryng.* **36:** 66, 1948.

Kristensen, H. K. An Improved Method of Decalcification, *Stain Technol.* **23:** 151, 1948.

A buffered agent that does not affect the staining or cause any damage to the labyrinthine tissues is used for decalcification of the bony labyrinth. The solution consists of equal parts of 8 N formic acid and 1 N sodium formate (pH 2.2). Only 24 hr. is required for decalcification, followed by continuous irrigation for a day and subsequent drying preparatory to embedding the tissue in paraffin.

Lange, E. Fifty Cases of Otosclerosis Operations (Fenestra Nov-Ovalis with Stopple According to Lempert), *Acta oto-laryng.*, supp. 74, p. 43, 1948.

The author uses the postaural route and ether anesthesia. The fistula is made by chiseling the most anterior position of the horizontal canal in the vestibulum. The best results were obtained in patients who had a bone-conduction loss of less than 30 db.

Lange, E. On Otosclerosis, *Maandschr. prak. Lægegerning* **26:** 281, 1948.

The author now operates without the stopple.

Lansberg, M. P. Possible Indications for the Fenestration Operation, *Nederl. tijdschr. geneesk.* **92:** 3590, 1948.

Lathrop, F. D. The Present Status of the Lempert Fenestration Operation, *S. Clin. North America* **28:** 801, 1948.

Leegaard, T. Otosclerosis and Its Surgical Therapy, *Tidsskr. norsk. lægefor.* **69:** 353, 1949.

Leegaard reports the follow-up observations on 49 patients for more than a year after surgical therapy of otosclerosis.

LeMée, J. M., and Henrot, H. Lempert's Fenestration Operation: Surgical Treatment for Progressive Deafness, *Presse méd.* **54:** 797, 1946.

The authors discuss and compare the methods of Lempert, Holmgren, and Sourdille.

Lempert, J. Lempert Fenestration Operation: Results in Otosclerosis, *Brit. M. J.* **1:** 997, 1948.

The author shows that, owing to penicillin, infection after fenestration operations is now of little importance. Results should be measured by audiometric findings, as the patients' statements are often misleading. He had not observed improvement in the hearing on the side of the untreated ear. Although 80% showed primary postoperative improvement after two years, only 60% of these were found to have good hearing.

Lempert, J. Bone-Dust-Free Lempert Fenestra Nov-Ovalis: A New Evolutionary Development of the Surgical Treatment of Clinical Otosclerosis, *Arch. Otolaryng.* **47:** 280 (March) 1948.

An account is given of a new technique devised to obviate the accumulation of bone dust within the perilymphatic space during the fenestration operation, which

accumulation may cause intraperilymphatic osteogenesis and possibly considerable deafness and make revision ineffectual. If the fistula closes by regrowth of bone at its rim, a revision is sometimes successful.

Lempert, J. Lempert Fenestra Nov-Ovalis for the Restoration of Practical Unaided Hearing in Clinical Otosclerosis: Its Present Status, *J. Laryng. & Otol.* **63:** 57, 1949.

The fenestra nov-ovalis is reviewed on the basis of 3,700 fenestration operations, with 450 revisions. Four principal operative factors in influencing the results at present are set forth and discussed. The author gives his opinions of the important points in the operative technique and of the causes of further losses of hearing and negative reactions to fistula tests. He regards the fistula test as no guide to the permanency of restoration of "practical hearing." Results after five years have shown that lead burnishing of the fenestra is not injurious to the endolymphic labyrinth or the organ of Corti. The immediate results appear to surpass those obtained when the lead burnishing was not used.

Lempert, J.; Wever, E. G.; Lawrence, M., and Meltzer, P. E. Perilymph: Its Relation to the Improvement of Hearing Which Follows Fenestration of the Vestibular Labyrinth in Clinical Otosclerosis, *Arch. Otolaryng.* **50:** 377 (Oct.) 1949.

Experience in 4,000 cases indicates that "fluid never escapes from the perilymph space beyond the bony margins of the newly created fenestra." No evidence was obtained to indicate an increased perilymph pressure in otosclerosis. Both the semicircular canal and the vestibular perilymph are entrapped in a spongelike mesh. Experiments on fresh temporal bones carried out according to von Békésey have been repeated in the living monkey. An increase of perilymph pressure to 50 mm. of mercury did not affect sound transmission through the middle ear and the cochlear fluids. It is concluded that otosclerotic deafness does not arise from increased perilymph pressure, nor does the improvement of hearing after fenestration result from decompression.

Lempert, J., and Wolff, D. Otosclerosis: Theory of Its Origin and Development, *Arch. Otolaryng.* **50:** 115 (Aug.) 1949.

This is the report on a second series of ossicle removals from 100 patients after fenestration operations, the largest age group in the series being between 20 and 50 yr. In 1945 the authors reported on an earlier series of 115 similar removals. In both series only four normal ossicles were found, and no typical otosclerosis. However, there were pathological changes in the joints, bony tissue, marrow spaces, and blood vessels in both series. The authors believed that the pathohistological examinations in their two series showed that in the ossicles there were always blood-vessel lesions similar to those observed in blood vessels of otosclerotic areas in the otic capsule. They endeavored to correlate these observations with the pathological picture in the ossicular bone. They entertained the theory that these vascular changes probably proceed from and are responsible for the bone lesions seen in otosclerosis. A single ossicle may show one or a combination of the pathological

bone changes. It was felt that although the lesions were minute they were significant because of what the authors believed to be their strategic location.

Lepage, G. The Surgery of Deafness Seen in the Light of Conclusions at the Meeting in Strasbourg, *Rev. méd. Liège* **3:** 594, 1948.

Shambaugh's technique is discussed.

Lewis, C. K. Fenestration in Otosclerosis, *Memphis M. J.* **23:** 48, 1948.

Liesch, E. The Influence of the Vestibular Apparatus on the Reflexes of the Patella and the Achilles Tendon, *Minerva med.* **2:** 318, 1947.

The patellar and Achilles tendon reflexes were accentuated immediately after the stimulation of the labyrinth by rotation.

Loch, W. E. A Modification of the Fenestration Operation Technique, *Ann. Otol. Rhin. & Laryng.* **57:** 1072, 1948.

The usual technique of making a window in the canal wall is modified by (*a*) leaving the final layers of bone intact as a "window plate" except at the edge, (*b*) lifting this plate as one piece after all use of burrs is completed, and (*c*) removing the thin edge of the "window frame" before removal of the plate. The author has used the technique since May, 1946.

Lumsden, R. B. The Fenestration Operation: Early Experience, *J. Laryng. & Otol.* **63:** 390, 1949.

The author used I. Simson Hall's technique in his first 21 fenestration cases, employing the postaural approach. Of 13 successful cases serviceable hearing was retained in 11.

Lund, R. The Popper Operation for Otosclerosis, *Acta oto-laryng.*, supp. 74, p. 29, 1948.

The author believes that shifting the fenestration site forward has made it imperative to use the anterior approach. Some modifications in technique are proposed. The author has successfully made fenestrae 1.5 by 2.5 to 3 mm. In four of his cases the membranous canal was damaged by suction. This caused a partial loss of vestibular function. However, no labyrinthitis appeared, and the acoustic function was not affected. The author believes that postoperatively the head should be maintained in the erect position to prevent the blood and exudate gravitating from the region of the fistula into the cochlea.

Lund, R. Popper's Operation for Otosclerosis, *Arch. Otolaryng.* **49:** 380 (April) 1949.

Popper's technique is discussed, and the results in 90 patients operated on by a modified technique are reported. It is observed that when the outer attic wall is vertical it is thin, but, when it is not vertical and continues the wall of the meatus inward, it is thick. Of the 90 patients operated upon there was an increased deafness in two instances six months afterward. In 50 other patients who had maintained

improved hearing for six months, 29 showed a positive fistula sign and in 21 it could not be elicited. It is believed that the Popper technique causes much less trauma than the Lempert procedure and is more quickly and easily carried out. Also there is less risk of infection of the mastoid cells.

This article is part of a group study. Other articles were by Ewertsen, Rasmussen, Riskaer, and Selsø.

Lurie, M. H. The Membranous Labyrinth in the Congenitally Deaf Collie and Dalmatian Dog, *Laryngoscope* **58:** 279, 1948.

Corti's organ was degenerated, the scala media collapsed, and the stria vascularis atrophied. The tectorial membrane was displaced and distorted or coagulated. The spiral ganglions and cochlear nerve were atrophied, and there was some degree of saccule collapse, macular degeneration, and saccular nerve atrophy. However, the endolymphic system with its neuroepithelium was normal. No more extensive abnormalities were found in the cochlea than had been observed in the waltzing guinea pigs. In the latter the scala media and tectorial membrane remained normal. The author found it difficult to understand how these findings can be explained if the stria vascularis is the sole source of the endolymph.

Lüscher, E., and Zwislocki, J. Transient Binaural Diplacusis and the Behavior of Threshold Values for Sound Intensity Differences After Fenestration in Otosclerosis, *Monatsschr. Ohrenh., Vienna* **83:** 184, 1949.

A case of transient binaural diplacusis after a fenestration operation is reported. The diplacusis disappeared when the hearing improved. The patient was able to differentiate between the subjective and objective tones. The authors concluded that this diplacusis was due to a change in the labyrinthine fluids and not to any disturbance in the neural mechanism of hearing.

Lux, W. Clinical Experiences with Suboccipital Puncture in Otosclerosis, *Ztschr. Laryng. Rhin. Otol.* **1[27]:** 94, 1948.

The author reports the removal of 40 to 50 cc. of cerebrospinal fluid from eight patients. In two of them there was temporary improvement of deafness and tinnitus; in one, disappearance of tinnitus; in another, temporary improvement of hearing alone, and in four of these patients neither the hearing nor the tinnitus was improved.

Magauran, W. H. B. Bone Conduction in Otosclerosis, *Brit. M. J.* **1:** 569, 1948.

In a letter to the editor Magauran reports a case in which the bone conduction improved in the ear not treated surgically immediately after fenestration operation.

Malossini, E. Notes on the Anatomy of the External Semicircular Canal in Man, *Arch. ital. otol.* **60:** 335, 1949.

After studying the anatomy of the adult external semicircular canal, the author concludes that the most suitable area for making the fenestration is the ampulla. The fenestra should not be made at the height of the vestibular dome but preferably at the level of the ampulla of the external semicircular canal.

Maxwell, J. H. The Chronic Discharging Ear After the Fenestration Operation, *Tr. Am. Acad. Ophth.*, supp., p. 39, 1949.

Of a total of 163 fenestration operations performed since 1921 the author found that 10 to 15% resulted in discharging ears. These were of three types: (1) discharge due to mucous cysts in the mastoid cavity which were developing from the residual membrane; (2) discharge caused by persistent pyogenic granulations which may continue; (3) chronic or recurrent discharge without much granulation tissue. About 10% were of the last type. The author recommends and describes his special endaural flap incision and his technique of removing the cartilage. He believes that this method provides more adequate ventilation for the mastoid cavity and that the new meatus being covered by skin would minimize the formation of granulations.

Maxwell, J. H. Training of Surgeon and Selection of Patient for the Fenestration Operation, *Tr. Am. Otol. Soc.* **35:** 202, 1949.

It is suggested that national societies elect a rotating board of otologists to pass on the qualifications of surgeons essaying to do the fenestration operation. Certification of proficiency should be issued to those who meet the standards.

Maybaum, J. L. Status of the Lempert Fenestration Operation (with Special Reference to Indications and Results), *Pract. oto-rhino-laryng.* **10:** 391, 1948.

Mayer, O. Remarks on the Question of Creating a Sound Fistula, *Pract. oto-rhino-laryng.* **10:** 168, 1948.

The sound fistula should be made without damage to the surrounding periosteum and should extend to the ampulla of the lateral canal. The fistula itself should not be covered by the flap but only the surrounding parts, in order to prevent the formation of granulations. It is necessary after two weeks to check the growth of granulation tissue with trichloroacetic acid. A rapidly progressive loss of hearing, a high degree of deafness, or an absence of caloric response are contraindications for the operation.

Mayoux, R. The Indications for Surgery in Deafness, *Lyon méd.* **180:** 447, 1948.

A brief historical review is presented, with descriptions of the various techniques. The fistula remained patent in about 75% of the author's cases. The operation offered little help if the hearing loss in the frequencies most important for speech exceeded 60 to 70 db. An improvement was seen only rarely in cases with cochlear lesions. In other types of middle-ear deafness the fenestration does not seem to be of benefit.

McFarland, J. Fenestration Operation for Otosclerosis, *Brit. M. J.* **1:** 804, 1948.

McFarland reports a case in which improvement occurred with a Thiersch-graft, lead-burnishing technique and use of penicillin with closure and without drainage.

McKenzie, W. Audiograms in Otosclerosis, *J. Laryng. & Otol.* **62:** 267, 1948.

The author divided the audiograms into 10-yr. interval age groupings and selected the most representative for each group. Composite audiograms for each

group were also plotted. The curve from the youngest to the oldest group varied from what the author called "a rising curve" through the flat curve to the "falling" curve in the older age group. The progressive nature of otosclerosis is shown by these curves. The "rising" type occurred in patients most suitable for fenestration (those in the 20- to 30-yr. group).

Meals, W. G. A Satisfactory Anesthesia for the Fenestration Operation, *Anesthesiology* **9:** 644, 1948.

The proposed anesthesia utilizes a basal narcosis consisting of heavy preoperative doses of morphine and barbiturates, as follows: pentobarbital (nembutal®), 0.2 gm. four hours before operation; morphine sulfate, 0.015 gm. three hours before; pentobarbital, 0.2 gm. two hours before; morphine sulfate, 0.015 gm. one hour before operation. This preliminary narcosis is supplemented by thiopental (pentothal®) in 2% solution. The method has been used in 800 cases. Latterly, the author reduced the prolonged effect by diminishing the total dose of thiopental and giving codeine sulfate, 0.03 gm., intravenously. Amphetamine sulfate, 10 mg., was employed for relief of respiratory depression.

Meda, P. The Fenestra Rotunda and the Secondary Tympanic Membrane, *Arch. ital. otol.* **58:** 55, 1947.

The anatomy of the fenestra rotunda and the round window membrane is set forth. The membrane along its principal axes is curved in two planes. In polarized light it appears to consist of two systems of collagen fibers parallel to the axes in such a manner as to make the membrane rigid. A layer of soft connective tissue separates the round window membrane from the mucosa of the middle ear. Owing to the position of this connective tissue and the structure of the membrane, sounds will be unable to pass through the fenestra rotunda to the cochlea.

Meltzer, P. E. The Fenestration Operation for the Relief of Deafness Due to Otosclerosis, *Bull. New England M. Center* **10:** 97, 1948.

A description is given of otosclerosis and of how the fenestration operation attempts to help the hearing. The author states that one can expect a good result in 50% of the patients operated on while another 15% achieve some degree of improvement. The operation does not stop the otosclerotic disease process; patients suitable for operation should have a good residual neural apparatus. The period between the ages of 16 and 50 yr. appears to be the most favorable.

Meltzer, P. E. Untoward Results of the Fenestration Operation, *Tr. Am. Acad. Ophth.*, supp., p. 32, 1949.

The author describes various injuries to the lateral sinus, the dura, and the facial nerve which are usually accidental and often unavoidable. The heat generated from the burr penetrates the bone and may affect the facial nerve by setting up an inflammatory reaction, or a fracture of the aqueduct of Fallopius may cause a paralysis of the facial nerve. In such instances wide decompression of the nerve is not necessary. Among more than 6,000 patients operated on by many expert surgeons, there have been reported only three cases of permanent paralysis.

Rupture of the membrana tympani may occur when the head of the malleus is removed before its neck is fully exposed. Such tears, if linear, will quickly heal,

whereas ragged tears will not heal and may impair the final functional result. Injuries to the lining of the external auditory meatus also may interfere with satisfactory improvements in hearing, particularly if such injuries interfere with proper sealing off of the epitympanic space from the middle ear. The author discusses the procedures indicated in such injuries and traumas.

An important cause of failure is injury to the membranous labyrinth, a delicate structure which is often unpredictable in its reactions to trauma. In practically all cases there is some bleeding into the perilymphatic space after the fenestration operation. When the bleeding is considerable, the blood tends to become organized in such a way that complete obliteration of the perilymphatic space results and any primary hearing improvement then will be lessened eventually or entirely lost. The tendency in recent years of making a small mastoid cavity and thereby leaving many cells unexenterated often results in prolonged suppuration. This, however, appears to have no great effect upon the hearing. Those who are to undergo the fenestration operation shoud be told that they will have need of otological attention for an indefinite time. Perichondritis of the auricle, mucous cysts, atresia of the external canal, removal of scar tissue, etc., may require diligent attention. Postoperative psychosis, though infrequent, is most distressing.

Meltzer, P. E., and Lewis, D. K. Results of the Fenestration Operation: A 6 Year Report of the Winthrop Foundation for the Study of Deafness at the Massachusetts Eye and Ear Infirmary, *Tr. Am. Acad. Ophth.* **52:** 546, 1949.

A report is given on 336 fenestrations covering a period from 13 months to six years postoperatively. The results, divided into four groups, were:

1. Successful hearing: Average loss for pure tones in the speech frequencies of not more than 30 db. Provided no single frequency is below 40 db., the average loss for these frequencies may be as low as 35 db. and the loss for speech no more than 30 db.

2. Improved hearing: Failure to reach the "practical level": (*a*) average improvement for both pure tones and speech of more than 17 db., (*b*) average improvement for both pure tones and speech of 10 to 17 db.

3. Unimproved hearing: Average improvement for the frequencies most useful in speech of less than 10 db.

4. Worsened hearing: Average loss for the frequencies most useful for speech of more than 5 db.

Of these fenestration patients 35% were classified as having successful hearing, 22% as having improved hearing, 32% as showing no improvement, and 10% as having the hearing made worse. The most successful results were obtained in those in whom the margins of the fenestra were burnished with lead (15.2% failure). About two-thirds of the patients reached the "practical level" in three to six weeks postoperatively, and about 54% remained above this level for periods varying from 13 months to more than six years. In the successful cases, 86.3% had a moderate or marked postoperative fistula reaction. In only four successful operations was the fistula reaction negative. However, it was negative in 17 of 19 patients whose hearing was made worse by the operation.

Meltzer, P. E. Revision of the Fenestration Operation, *Tr. Am. Otol. Soc.* **35:** 207, 1949.

Revision improves hearing in only a small number of patients. When well selected, a return to the practical level of hearing occurs in about 20 to 25%. In 15 to 20% of the remainder the hearing may improve but is short of the practical level. There is more danger of making the hearing worse by revision than by the original operation. It would appear that osteogenetic and fibrous changes are beyond human control. The history in these patients is important, and a detailed questionnaire is outlined.

Menzio, P. Tullio's Reflexes After Fenestration Operations, *Boll. Soc. ital. biol. sper.* **25:** 442, 1949.

In 12 cases the opening of the semicircular canal resulted in a nystagmus, usually directed to the contralateral side. A loud tone of 80 to 100 db., and between the frequencies of 128 and 1024 by either air or bone conduction in all but one, caused an increase in the degree and frequency of the nystagmus. After the disappearance of the spontaneous postoperative nystagmus, similar acoustic stimulations set up a nystagmus, directional changes in posture of the body, and deviation of the arms, all in the direction of the slow component of the nystagmus, which was usually to the ipsilateral side.

Miodónski, J. The Operative Treatment of Otosclerosis, *Otolaryng. polska* **2:** 18, 1948.

In 18 cases the results obtained using the postauricular incision corresponded with those obtained by other operators.

Miodónski, J. Nystagmus During and After Fenestration, *Bull. internat. Acad. polon. sc. et lett.* **1:** 103, 1949.

The nystagmus during the fenestration operation depends upon the temperature of the solution used for irrigation. After the fistula opening is made and after a strong deviation toward the contralateral side, there supervenes a horizontal and rotatory nystagmus toward the side operated on. After a variable length of time this nystagmus gradually reverts to the contralateral side. It is a sign that the membranous labyrinth has been injured if immediately after the operation the nystagmus is toward the ear operated on.

Miskolczy-Fodor, F. I. Factors of Impaired Hearing in Otosclerosis, *Monatsschr. Ohrenh., Vienna* **82:** 27, 1948.

In eight patients who had a nonlateralized Weber reaction before the fenestration operation, there was no change postoperatively in five instances, whereas in the other three the Weber reaction was lateralized to the surgically treated side. A discussion of the possible theoretical explanation of these phenomena is set forth, and the author concludes that the benefit derived from the operation cannot be due to the removal of the impedance of the sound-conduction mechanism, but that the reversal part of the inner ear lesion is affected by the decompression. The author

also believes that the inner ear lesion must develop much earlier than is assumed, and that the loss of hearing must be due to a combined type of deafness, the impedance factor overshadowing a less pronounced neural factor. The inner ear lesions may develop but remain latent for some time and may be obscured by the preponderating impedance caused by stapes ankylosis.

Morrison, W. W. Present Status of Fenestration Operation for Otosclerosis, *New Orleans M. & S. J.* **101:** 222, 1948.

Moulonguet, A., and Bouche, J. Congenital Absence of the Semicircular Canals, *Ann. oto-laryng.* **65:** 333, 1948.

The 25-yr.-old patient had otosclerosis, but no canals or ampullae were found. Roentgenograms showed normal pneumatization. The results of vestibular tests were negative on the side operated on and disclosed normal conditions on the other side.

Moulonguet, A., and Bouche, J. Graft of Palpebral Skin in the Fenestration Operation, *Ann. oto-laryng.* **66:** 55, 1949.

Mygind, S. H. Experimental-Histological Studies on the Labyrinth, *Acta oto-laryng.* **35:** 108, 1947.

Mygind, S. H. The Problem of the Petromyzon Labyrinth, *Pract. oto-rhino-laryng.* **10:** 292, 1948.

This is a discussion of the hypothesis that the ciliated sacs in the labyrinth of the lamprey (Petromyzon) function somewhat in the manner of a gyroscopic compass.

Nielsen, A. S. Nov-Ovalis Operation for Otosclerosis According to the Method of Lempert, *Ugesk. læger* **110:** 55, 1948.

The results obtained in 17 patients by the use of the cartilaginous stopple according to Lempert's method are reported. Five of these patients showed some improvement of their conversational voice.

Nylén, B. Histopathological Investigations on the Localisation, Number, Activity and Extent of Otosclerotic Foci, *Upsala läkaref. förh.* **54:** 1, 1949; *J. Laryng. & Otol.* **63:** 321, 1949.

The author investigated 74 cases of otosclerosis in Nager's material. The number of otosclerotic bones was 121; the proportion of women to men was 0.85 : 1. The cochlear capsule was involved in 35%, the internal auditory meatus in 30%, and the region of the semicircular canals in 15%.

The oval window regions showed the greatest predilection for the foci. A large number (60%) of lesions of the oval window region were not accompanied with ankylosis of the stapes, while 50% of the total number of patients showed ankylosis. Distributional variations of the foci were found to be related to sex in some instances. Ankylosis was present in 17 and absent in nine of the women, and it was present

in 19 and absent in 22 of the men. The author remarks that this higher incidence of ankylosis in women may account for the disease being clinically more frequently found in females. He refers to his earlier statements regarding the occurrence of the disease histologically, i. e., "that in many investigations it is found as frequently in men as in women." Single foci were observed in 42 instances (55% of the patients). The oval window was mainly involved in these single lesions. The round window and other parts of the capsule were involved less frequently. The author points out that in a little more than one-third of the patients with demonstrable stapes ankylosis the otosclerotic focus was localized in the oval window region alone. In the remaining two-thirds of the patients, the lesion was greater in extent and the foci were found in other regions. When bilateral, the foci were usually symmetrically situated and were of mixed appearance in 50% of the patients. In persons who died at 50 yr. of age and older, in no instance were all the lesions active. In those under 50 yr. of age, active foci were quite commonly found. The size of the foci was found to vary roughly from 0.4 to more than 20 mm. In 10% of the patients the otosclerotic lesions were diffuse. Otosclerosis was unilateral in 25%, and the incidence of ankylosis was less in the patients with the unilateral disease.

Ombrédanne, M. Fenestration in Children with Aplasia of the External Ear and Atresia of the Auditory Canal, *Ann. oto-laryng.* **65:** 323, 1948.

Fenestration operation on children with aplasia of the external ear and atresia of the auditory canal is difficult and unsuccessful because there is little space in the undeveloped bone, which makes it difficult to find the usual landmarks. However, results of the operation seem to be improving and to justify the expectation that the improvement in hearing achieved will be permanent. The fistula is covered with a thin piece of skin (from behind the ear, not from the thigh), which is also used for lining the newly formed antrum and meatus. Two cases are described. The chief difference between the usual fenestration operation for otosclerosis and this procedure is the fact that no ossicles or drum membranes, etc., are present, although there may be rudiments. Moreover, there is in these cases no progressive deafness.

Ombrédanne, M. Surgery for Deafness in Children: The Fenestration Operation in Cases of Aplasia of the Auricles and Atresia of the External Auditory Canal, *Arch. franç. pédiat.* **4:** 587, 1947.

The author obtained an improvement of hearing in a case of congenital atresia of the external ear with anomalies in the internal ear by a fenestration operation. The operation was much more difficult than in otosclerosis. Two cases are reported.

Passe, E. R. G. Bone Conduction in Otosclerosis, *Brit. M. J.* **1:** 754, 1948.

In a letter to the editor Passe states that it has been known for some time that improvement of hearing by bone conduction occurs in the untreated ear in a certain number of cases after the fenestration operation, but this improvement is never permanent.

Passe, E. R. G. A Second Interim Report on the Results of Over 500 Cases of the Fenestration Operation: Factors Attributable to Success and Failure, and a Description of a Modification in the Author's Fenestra, *J. Laryng. & Otol.* **63:** 495, 1949.

This is a report of the results obtained in 500 operations performed by the author in the last 13 years. Attention is called particularly to a technique in which a large fenestra is made, extending from the vestibule along the external semicircular canal. It is thought that this bony "hooding" protects the projecting membranous canal from possible compression.

Passe, E. R. G. The Fenestration Operation, *Irish J. M. Sc.*, p. 145, 1948.

Patients with clinical otosclerosis may be classified into one of three groups, each of which may have a certain expectancy of result from the fenestration operation: (1) those with good nerve function; (2) those with some nerve deterioration; (3) those with extensive cochlea and nerve deterioration with little or no probability of improvement in the hearing. The author now believes that the bone conduction may be lowered even to 35 or 40 db. at the middle frequencies and yet not necessarily indicate that no improvement in the hearing may be obtainable by operation. He believes that the removal of the periosteal bone may so devascularize the capsule that the otosclerotic process may be retarded. The author makes his fenestra as long as possible and contours the external canal so that the opening can be made on the top of the remaining mound. He states that since he has discontinued the use of the stopple and employed the technique he outlines there has been a marked diminution in the instances of postoperative labyrinthitis. In his patients, tinnitus was diminished in about 25% and after two and a half years the hearing remained improved in 51%. In 39% of his patients the hearing was improved, but later the improvement was lost. The hearing either was not improved or was made worse in 10%.

Pfändler, U. Heredity of Otosclerosis, *Schweiz. med. Wchnschr.* **79:** 692, 1949.

Clinical studies on a family in Switzerland with many progeny and ancestors who had lived in the same region for centuries, with several consanguineous marriages, led to the conclusion that otosclerosis is a distinct nosologic entity which is caused by a genetic mutation with dominant characteristics. Otosclerosis in the heterozygous state rarely manifests itself, and when it does it appears to be less severe and to occur at an older age. When the hereditary factor fails to manifest itself for several generations, one should not assume a recessive heredity. It should be remembered that histologic examination of the otic capsule reveals the incidence of otosclerotic foci to be about 10% of the population. Clinical manifestations of heterozygous otosclerosis can be influenced by exogenous, as well as by endogenous, factors. Heterozygous otosclerosis may vary according to strains and families. If there are two allelomorphic genes conditioning otosclerosis in association, a homozygous manifestation of the disease occurs and may appear in a severe form and usually at a relatively early age. Even though otosclerosis of this type occurs in the usual way and at the usual relatively early age of the patient, a study of the family strain shows that both the severity of the disease and the age of the parents

can vary with the endogenous environment. It is permissible to admit the existence of different mutations, any or all of which might predispose to otosclerosis. Truly, otosclerosis is homozygous if there is a consonance between two allelomorphic genes and only then.

Philip, R. Otosclerosis Surgery, *J. méd. Bordeaux* **125:** 63, 1948.

Philip presents a survey of the recent history of the fenestration operation, with emphasis on the removal of bone particles, saline irrigations, proper magnification, performance of several audiographic studies, and vestibular testing before the operation is performed. A comprehensive medical examination and roentgenograms of the mastoids are also advocated. The author discusses postoperative medication to avoid vomiting and congestion of the flap, including administration of penicillin daily for 10 days and timing of the dressings. He notes that paralysis of the facial nerve has never been reported following the Sourdille technique. The prognosis is based on both the air-conduction and the bone-conduction loss. The interrelation of these is utilized, and several classes are set up, with the percentage of probability of improvement for each. It is believed that the techniques have been improved and may possibly still further improve.

Philip, R. Structure of the Osseous Labyrinth Capsule, *Rev. laryng., Bordeaux* **69:** 319, 1948.

The various layers of the labyrinthine capsule, and particularly the embryological aspects, are described and their importance stressed in connection with the fistula operation. The author emphasizes the fact that new bone is formed from the periosteal layer only.

Philip, R. The Development of the Bony Labyrinth Capsule, *Rev. laryng., Bordeaux* **68:** 575, 1947.

The author presents a summary of knowledge of the development of the osseous labyrinth capsule. Both the internal and the external perichondral layers completely ossify, but the intermediate cartilaginous layer ossifies only in part, and in the sixth month this ossification stops, thus leaving for the remainder of life residual cartilage and bone in this zone. This residual cartilage and bone have no tendency to change or to form callus in the bed of fracture. The author believes that his data are of considerable practical importance in the problems of otology and their surgical treatment.

Popper, O. Transtympanic Fenestration: Where is the Borderline? *South African M. J.* **22:** 42, 1948.

The author still is of the opinion that "to approach tympanic structures by exenterating the mastoid process is not only unnecessary but undesirable." He states that the logical way to avoid a "moist" cavity after the fenestration operation is to use his transtympanic approach and thereby avoid the creation of a mastoid cavity. He has developed his technique somewhat and classifies cases in five categories of severity. The complications he encountered in 50 cases are set forth. Otitis media was encountered six times and paralysis of the facial nerve six times. One case of facial paralysis, he believes, will require the decompression operation.

Popper, O. Hydrodynamics and Hearing: I. The Operative Relief of Otosclerotic and Nonotosclerotic Deafness and Its Relationship to a Hydrodynamic Hypothesis of Hearing: A Suggested Explanation for (a) the Intimate Association of the Organs of Balance and the Organ of Hearing and for (b) the Function of the Incus, *Arch. Otolaryng.* **49:** 335 (April) 1949.

The author asks and discusses the following questions: What is meant by hydrodynamics? How does fenestration restore hearing, and is such restored hearing normal? What is the protective role of the stapes, the perilymph, and the round window membrane? Why are the organs of balance and the organ of hearing so intimately related to each other? He classifies his surgical cases to conform with the hydrodynamic hypothesis. This article cannot be well abstracted; it should be read.

Popper, O. Transtympanic Approach and Fenestration: II. The Current Technic, *Arch. Otolaryng.* **49:** 350 (April) 1949.

The author reviews his pretragal transtympanic technique.

Pothoven, W. J. The Improvement of Hearing in the Non-Operated Ear After Fenestration Operation, *Nederl. tijdschr geneesk.* **92:** 730, 1948.

The improvement of hearing in the surgically untreated ear after fenestration operation is not conclusively explained. The author points out that a postoperative diminution of hearing in the untreated ear is also encountered. Venker demonstrated an improved vascular reaction in the ear not operated on in 80% of his patients. It would, therefore, seem that the vasomotor theory of Gray and Sourdille does not hold true in all cases.

Poulsen, I. P. V. Popper's Operation for Otosclerosis: Results, *Ugesk. læger* **111:** 145, 1949.

Proud, G. O., and Walsh, T. E. Irradiation Therapy of Fenestration and Radical Mastoidectomy Cavities, *Laryngoscope* **59:** 1255, 1949.

The standard nasopharyngeal application (50 mg. of radium sulfate) was employed for 12 min. three times at weekly intervals in those cases of fenestration and mastoidectomy cavities which continued to discharge and granulate. Improvement was noted in 25 of 30 cases.

Rasmussen, H. Vestibular Function Prior to and Following Operation for Otosclerosis, *Arch. Otolaryng.* **49:** 402 (April) 1949.

The author's summary follows:

The vestibular function has been tested in 79 patients before and after operation for otosclerosis.

Twenty-seven per cent of the patients had been suffering from vertigo before the operation. This symptom was present after the operation in 64 of the 79 patients.

Spontaneous nystagmus was demonstrated in the majority of the patients after the operation, varying in both duration and direction.

The fistula sign was originally present in 57 patients, but later disappeared in 11. If the fistula is still open six months after the operation, it is likely to remain so. The fistula sign was generally regular. The direction may differ with the different methods of testing. The vascular fistula sign was a frequent occurrence, also after the area of operation had healed. This sign is, in other words, not released by changes of volume of the granulation tissue in the fistula.

In rotation and caloric tests, some patients presented signs of a lesion of the vestibular apparatus before the operation. After the operation such signs were frequent, notably signs of damage to the horizontal canal and, less frequently, to the two vertical canals.

The fistula sign may be absent despite functioning of the horizontal canal, and, reversely, the fistula sign may be elicited despite loss of function of the horizontal canal.

This article is part of a group study. Other articles were by Lund, Ewersten, Riskaer, and Selsø.

Rasmussen, H. Studies of the Effect on the Air Conduction and Bone Conduction from Changes in the Meatal Pressure in Normal Subjects and Otosclerotic Patients, *Acta oto-laryng.*, supp. 74, p. 54, 1948.

Air conduction in both normal and otosclerotic patients was associated with a decrease in intensity of perception of the lower frequencies during positive and negative pressures and of the higher frequencies during negative pressure. However, during positive pressure the higher frequencies were increased in loudness. In normal persons similar findings were obtained using bone conduction. Before operation in otosclerotic patients bone-conduction sounds were not influenced by pressure changes; after operation they were affected. The author is of the opinion that the change in the conducting mechanism is the cause of the air-conduction response to pressure variations, and altered labyrinthine pressure changes are responsible for the changes observed by bone conduction. Because in otosclerotic patients who maintained some air-conduction reception by way of the middle ear the bone conduction is not changed by air-pressure changes, it is thought that bone conduction by way of the ossicle chain is of little importance compared with the conduction through the bones of the skull.

Rebattu, J., and Martin, H. The Value of Paracusis in Judging the Indications for Fenestration, *J. méd. Lyon* **30:** 749, 1949.

The authors believe that if there is a marked paracusis it is a favorable sign, so far as the success of the fenestration operation is concerned. It proves that the inner ear is still functionally intact. Although a lack of paracusis does not necessarily contraindicate the operation, its disappearance indicates a loss in the functioning of the inner ear and as such is an unfavorable sign for operation.

Rebattu, J. Surgical Treatment of Deafness, *J. méd. Lyon* **30:** 507, 1949.

This is a review of the subject.

Rebattu, J., and Gaillard, J. Improvement of Hearing in the Contralateral Ear Following Fenestration, *Lyon méd.* **181:** 333, 1949.

Rebattu, J., and Martin, H. Fenestration Carried Out in Cases Other Than Those of Classic Otosclerosis, *J. méd. Lyon* **30:** 719, 1949.

In seven patients in whom deafness was due to suppuration, a satisfactory result was obtained by fenestration. The operation was also of benefit in one patient with traumatic deafness who showed a nonresponsive vestibular labyrinth, although the bone conduction was good. Good results were obtained with the operation in a case of congenital deaf-mutism in a 10-yr.-old child who appeared to have adequate function of the inner ear.

Rebattu, J., and Martin, H. Fenestration of the Labyrinth: Results in 25 Cases, *J. méd. Lyon* **30:** 745, 1949.

Rebattu, J., and Martin, H. Measures to Prevent the Occlusion of the New Window in Fenestration Operations, *J. méd. Lyon* **30:** 753, 1949.

An attempt was made to use a hollow acrylic stopple tube shaped with a horizontal plate at one end. This was designed to fit into the fenestra, and the plate served to raise the skin flap and thus possibly increase the transmission of sound vibrations. Among 50 cases a large number of successes was obtained. The authors experimented with a two-stage fenestration operation, cutting the flap in the first stage and thinning down the bony wall of the labyrinth until the lumen was visible; in the second stage, a free skin graft was designed to lie immediately over the fistula on the under surface of the skin flap. Two weeks later the flap was raised and the fenestration completed.

Remorino, A. The Surgery of Deafness, *Rev. méd. Córdoba* **36:** 444, 1948.

The principles of operative treatment are summarized, and the importance of accurate audiometric examinations is stressed.

Riskaer, N. Biochemical Conditions in Patients with Otosclerosis, *Arch. Otolaryng.* **49:** 414 (April) 1949.

The literature on metabolic studies in clinical otosclerosis is reviewed, and it is pointed out that no significant deviations from normal in the blood calcium, inorganic phosphates, cholesterol, and proteins have been found. The author adds globulin and albumin to these with the same results. Some investigators did find a few values above or below normal.

This article is part of a group study. Other articles were by Lund, Ewertsen, Rasmussen, and Selsø.

Rosen, S. Fenestration for Otosclerosis, *J. Mt. Sinai Hosp.* **14:** 98, 1947.

Rosen describes the fenestration operation, with details of two cases.

Rosen, S. Observations on Surgical Anatomy in the Fenestration Operation, *Ann. Otol. Rhin. & Laryng.* **57:** 1007, 1948.

This is a study based on 400 fenestration operations performed on fresh adult cadavers. The distance from the mastoid cortex to the bottom of the antrum, the distance of the fenestra from the facial nerve, the size of the fenestra, and the comparative distance from the short process of the malleus to Shrapnell's membrane and from the short process of the malleus to the fenestra were measured. It was found that the size of the fenestra differed from that reported by Lempert. The

author believes that Shrapnell's membrane cannot be made to reach the fenestra, and that what is used to cover the fenestra is skin and not mucosa. The author stresses the need of operations on cadavers before attempting to operate on living human beings.

Rosen, S. Is It Possible to Cover the Fenestra Nov-Ovalis with Shrapnell's Membrane? An Anatomic Study, *Arch. Otolaryng.* **49:** 529 (May) 1949.

In 50 fenestration operations performed on fresh cadavers, there was no instance in which Shrapnell's membrane covered the fenestra. Since the distance between the upper limit of Shrapnell's membrane and the short process of the malleus is less than one third of the distance from the short process to the fenestra, it appears most improbable that Shrapnell's membrane can reach the fenestra.

Rosen, S. Chorda Tympani Nerve Section and Tympanic Plexectomy: New Technique Used in Cases of Deafness, Tinnitus and Vertigo, *Arch. Otolaryng.* **50:** 81 (July) 1949.

The chorda tympani was separated from the facial nerve and placed over the membranous labyrinth after fenestration. Eight cases with excellent results are reported. In two other cases with excellent results the mucosa over the promontory was removed in addition, together with Jacobson's nerve. These procedures were followed by relief of tinnitus in one case and of vertigo in another. There was also some improvement in the hearing. The rationale of sectioning the chorda tympani and the tympanic plexus is discussed.

Rosen, S. Chorda Tympani Nerve Graft: II. Report of Follow-Up Observations One Year Postoperatively, *Arch. Otolaryng.* **50:** 243 (Sept.) 1949.

Excellent results are described after a year's follow-up of five cases in which the chorda tympani nerve graft was used as a modification of the fenestration operation.

Rosenwasser, H. When Is a Case of Clinical Otosclerosis Suitable for Fenestration? *Laryngoscope* **58:** 244, 1948.

Rutherford, I. M. Otosclerosis, *New Zealand M. J.* **46:** 486, 1947.

Sadovsky, N. The Surgical Treatment of Otosclerosis, *Harefuah* **37:** 121, 1949.

Salém, W. A. Lempert's Fenestration Operation for Treatment of Deafness: Results of 7 Cases, *Rev. brasil. oto-rino-laring.* **15:** 101, 1947.

The author encountered no complications worth mentioning after the fenestration operation according to Lempert's technique. Four patients showed a gain of 30 db.; in one the hearing remained good one year after the operation; two patients achieved a moderate gain of 15 db.; one patient's hearing remained unchanged. The author discusses whether the operation is worth while when the results obtained can be present only for a limited period.

Salmon, M. J. Some Remarks About the Fenestration Operation: Results of 31 Operations, *Ann. oto-laryng.* **65:** 553, 1948.

Salmon reports the results of 31 fenestration operations.

Saltzman, M., and Ersner, M. S. Tinnitus Aurium in Otosclerosis, *Arch. Otolaryng.* **50:** 440 (Oct.) 1949.

The authors state that tinnitus is constantly present in the active stage of otosclerosis, and that it disappears when the air-conduction threshold reaches the 60 to 90 db. loss level. "On the assumption that a 'trigger sound' from the outside initiates the tinnitus, the localization of the sound to one side of the head may be explained by the Stenger phenomenon." Frequently tinnitus is favorably influenced by the use of a hearing aid; sometimes the reverse occurs. The authors "feel justified in stating that in otosclerosis the dampening power of the ear is impaired in respect to specific sounds and that some extraneous sounds have a trigger effect in the initiation of tinnitus."

Schlander, E. Two Cases of Fenestration, *Monatsschr. Ohrenh., Vienna* **82:** 273, 1948.

Schneider, D. E. The Growth Concept of Nervous Integration: VI. A. On Real Hearing: First Contribution to a New Theory of Hearing; The Tympanic Plexus as a Critical Portion of the Vegetative Sound System; The Neurophysiologic Rationale for Tympanic Plexicectomy, *J. Nerv. & Ment. Dis.* **105:** 133, 1947.

This article should be read because the hypotheses it presents are interesting but difficult to abstract. The author believes that the integrity of hearing is determined by the vegetative nervous system; while tinnitus is present, this nervous system is alive, and when the tinnitus stops in cases of otosclerosis the patient becomes totally deaf. The argument would seem to furnish a rational indication for excision of the tympanic plexuses (tympanic plexicectomy). Thus, a cure would be offered for this type of tinnitus by anticipating the natural loss of function of the tympanic plexus.

Selsø, S. Conditions of the External Auditory Meatus and the Tympanic Membrane in Patients with Otosclerosis, *Arch. Otolaryng.* **49:** 420 (April) 1949.

Twenty-nine patients between the ages of 26 and 67 yr. suffering from otosclerosis were examined. The findings were compared with those in 29 normal controls. A table shows the comparisons. No translucent redness was seen through the tympanic membrane in any person of the two groups. It is believed that such "redness is not due primarily to hyperemia of the mucosa of the middle ear but rather to transillumination of an abundance of blood in the new-formed bony tissue in the promontorial wall." The cerumen production was noted to be the same in the two groups. The conclusion is drawn "that the external auditory meatus and the tympanic membrane present no characteristics that may contribute to differentiate otosclerosis from other forms of deafness."

This article is part of a group study. Other articles were by Lund, Ewertsen, Rasmussen, and Riskaer.

Senff, A. F. Findings in the Cerebrospinal Fluid in Otosclerosis, *Deutscher med. Rundschau* **1:** 436, 1947.

Puncture of the cistern was performed on 24 patients with otosclerosis, and 6 to 12 ml. of cerebrospinal fluid was withdrawn. Its protein content was found

to be increased in three patients and considerably increased in two others. It is suggested that in these patients there was a definite form of otosclerosis or that the otosclerotic process had reached a certain stage. There was no improvement in the hearing or any diminution in the tinnitus in any of the patients.

Shambaugh, G. E., Jr. Fenestration Operation for Otosclerosis: Experimental Investigations and Clinical Observations in 2,100 Operations over a Period of 10 Years, *Acta oto-laryng.*, supp. 79, p. 5, 1949.

The author gives a comprehensive history of the beginnings and evolution of the fenestration operation and discusses the development of the otic capsule and the variations observed in otosclerotic lesions. This contribution should be read, as it cannot be briefly abstracted.

Shambaugh, G. E., Jr. Effect of Fenestration Operation on Nerve Degeneration of Otosclerosis, *Tr. Am. Acad. Ophth.*, supp., p. 42, 1949.

The author states that in most cases of otosclerosis, although the etiological basis is not well understood, sooner or later there is a neural type of deafness. The effect of the fenestration operation in 231 cases was studied five to eight years postoperatively. An immediate postoperative increase in bone conduction, though frequently present, is often transient but is usually restored within a few days. Loss in bone conduction is probably due to cochlear damage and can be minimized by taking precautions, such as proper control of the bleeding through local anesthesia, administration of the antibiotics, and proper packing.

The data presented suggest that the fenestration operation may tend to arrest or inhibit progressive nerve deterioration in the operated ear in some cases of otosclerosis. This conclusion must be regarded as tentative until such time as more evidence has accumulated.

Shambaugh, G. E., Jr. The Fenestration Operation: Selection of Cases and Training of the Surgeon, *Wisconsin M. J.* **48:** 731, 1949.

Siirala, U. Plastic Correction of Congenital Atresia of the External Auditory Meatus Combined with Fenestration to Improve Hearing, *Acta oto-laryng.* **37:** 307, 1949.

After reviewing the literature on congenital atresia, the author reports a case. As one ear was normal, the operation was performed mostly for psychological reasons. Local anesthesia was employed. A postaural rectangular skin flap was cut so as to form a backwall for the new wide canal. Postaurally a chink was left, so small that it was visible only on pulling the pinna. The fused incus and malleus were removed, and a large fenestra was made and covered by a Thiersch graft. There was improvement of 35 db. in the critical speech frequencies but not above the 30 db. level. The author thinks that possibly two fenestrae might have been more satisfactory. Healing was complete in two months.

Silverman, S. R.; Thurlow, W. R.; Walsh, T. E., and Davis, H. Improvement in the Social Adequacy of Hearing Following the Fenestration Operation, *Laryngoscope* **58:** 607, 1948.

A questionnaire sent to 161 patients who had been subjected to the fenestration operation and who had been tested audiometrically and by the speech tests, and also checked by the social adequacy index, before and a few months after the

operation showed the following: A "threshold zone" of hearing extends from a hearing loss for speech of about 30 db. (social adequacy index 67), at which patients begin to have significant social difficulty, to a loss of about 60 db. (social adequacy index 10 or less). At the latter level, called the "limit of compensation," speakers cannot or will not talk loudly enough to be understood by the hard of hearing. The middle of the threshold zone, about 45 db. of loss for speech (social adequacy index 33), is taken as the "threshold of social adequacy of hearing." Throughout the threshold zone patients reported that before operation their understanding on the average was with "slight" and "considerable" difficulty. If the hearing was within the threshold zone both before and after the operation, the patient usually considered the operation successful, even if he gained only 5 db. hearing for speech (social adequacy index 10). Statistical calculations are presented to show the relationship between results of preoperative tests, the actual improvement of hearing, and the subjective improvements reported in the questionnaires.

Smith, H. W. Effect of Pregnancy on Otosclerosis, *Arch. Otolaryng.* **48:** 159 (Aug.) 1948.

The author's summary and conclusions follow:

Reports in the literature since July 1938 that were reviewed show that the effect of pregnancy on otosclerosis and its incidence, as well as the hereditary influences involved, are variable and unpredictable.

Of 73 otosclerotic women studied at the New York Eye and Ear Infirmary, 29 per cent had a history of familial deafness.

The weight of evidence in the literature reviewed and the results of the study presented agree that eugenic measures are ineffective in the prophylaxis of otosclerosis.

Heredity plays little or no part in the effect of pregnancy on otosclerosis.

Hearing loss may be present prior to child bearing and then be further increased by it; 14.7 per cent of the 73 patients studied demonstrated this:

6.8 per cent had hearing further damaged by first gestation.

3.9 per cent had hearing further damaged by first and second gestation.

2.6 per cent had no further damage of hearing with first gestation but did with second.

1.3 per cent had further damage with first and second gestation but not with third.

The onset of hearing loss was initiated by pregnancy in 22.9 per cent of the 73 patients studied:

10.7 per cent noted onset with first child; 3.9 per cent had a second child, with more loss.

6.8 per cent noted onset with second child; 1.3 per cent had a third child with more loss.

5.4 per cent noted onset with third child.

In rare instances, otosclerosis improves during pregnancy.

Hearing aids and fenestration of the labyrinth may offer relief to patients afflicted with otosclerosis.

Abortion and sterilization are not indicated in the average case of otosclerosis complicated with pregnancy.

Smith, J. M. Report of 425 Fenestration Operations for Clinical Otosclerosis, *Southern M. J.* **41:** 198, 1948.

Results of 425 fenestration operations for clinical otosclerosis are reported. In no instance was there a facial paralysis, serious intracranial complications, or death. The oldest patient operated upon was 67 yr. of age and the youngest 9 yr.

Solero, C. The Surgery of Deafness: Considerations on the First 10 Operated Cases, *Boll. mem. Soc. piemontese chir.* **18:** 391, 1948.

Shambaugh's technique was used. All patients recovered within two to four months, and all showed a considerable hearing improvement which has now persisted for six months.

Sourdille, M. On the Surgery of Otosclerosis, *Ann. oto-laryng.* **65:** 550, 1948.

The author accepts the principle of the one-stage operation without abandoning the two-stage operation in special cases.

Sourdille, M. Surgical Treatment of Otosclerosis, *Acta oto-laryng.* **37:** 195, 1949.

The author believes that the successful "surgical treatment of otosclerosis" depends upon (1) establishment of a permanent labyrinth fistula and (2) proper mobilization of a membranous covering to the fistula. He believes that no important principles have been added to those that he suggested in 1935; irrespective of the instruments and techniques devised there has been no real advance. Sourdille states that the usual percentage of successes is 50, and that the only way to increase this percentage is to reopen the closed fistulas. In his opinion the incus, except in cases of slight deafness, should be removed; the head of the malleus should be removed. It is his view that the preservation of the incus is of value only if the operation is performed in two stages, and the incus held in a cutaneous and cicatricial flap. This supplies maximum mobility to the ossicles.

Spake, L. B. The End-Results in the Lempert Fenestration for Clinical Otosclerosis (with Special Reference to the Mobile Stopple), *Tr. Am. Laryng. Rhin. & Otol. Soc.* **50:** 293, 1946.

The surgical treatment of otosclerosis to raise the hearing to the "practical level" is based on the following conclusions: 1. Suitable patients must be chosen. 2. A flap as thin as possible and complete removal of bone dust and spicules are necessary; the middle ear and the newly created fistula must be completely dried of blood. 3. The fistula should be made in the surgical dome of the vestibule. 4. The cartilaginous transplant must be mobile and not fill more than one-third of the fenestra. 5. Removal of the sulfathiazole-ointment gauze pack on the fifth day, and replacement with aqueous solution of methylrosaniline chloride (gentian violet), is the most satisfactory postoperative treatment.

Stevenson, R. S. Bone Conduction in Otosclerosis, *Brit. M. J.* **1:** 618, 1948.

Stevenson in a letter to the editor writes as follows:

What is most urgently needed to-day in regard to the over-publicized fenestration operation for otosclerosis is a careful, sober, and dispassionate estimation of end-results.

Swanson, C. A., and Delaney, A. J. The Modern Treatment of Progressive Deafness, *U. S. Nav. M. Bull.* **48:** 1, 1948.

The authors discuss the management and surgical treatment of otosclerosis as it affects United States Navy personnel.

Tezel, E. B. Surgical Treatment of Otosclerosis, *Türk tib. cem. mec.* **12:** 364, 1946.

Thurlow, W. R.; Silverman, S. R.; Davis, H., and Walsh, T. E. A Statistical Study of Auditory Tests in Relation to the Fenestration Operation, *Laryngoscope* **58:** 43, 1948.

Results of various tests are correlated as to their repeatability. The tests were made on 161 persons before and at various intervals following fenestration operations. The analysis of the results shows the following:

Test No. 9 ([threshold for] spondaic words) and Test No. 12 [threshold of sentence intelligibility] [2] have a standard error of measurement of about 4 db. The reliability is about the same as for pure-tone audiometry. [Tests 9 and 12 were developed in the Psycho-Acoustic Laboratory, Harvard University.]

Hearing losses for speech determined by all of the speech tests [used] correlated so closely with one another that only one of them need be used in any clinical routine.

The prediction of the thresholds for speech from the losses for pure-tones (averaged over the speech range) is less satisfactory than the prediction from one speech test to another.

Discrimination for speech measured by the articulation scores obtained on word lists given at high intensity, is better for cases that are predominantly conductive deafness than for cases with a significant amount of nerve deafness.

The best results from the fenestration operation, based on tests within eight months postoperative, were obtained in the cases of predominantly conductive deafness, but none of the tests employed showed any great predictive value.

The average gain for speech (eight months postoperative) was about 14 decibels. The average gain for pure tones in the speech range was about 9 decibels. Pure-tone audiometry significantly underestimated the gain for speech.

No difference in the average *immediate* gain for speech appeared to be associated with any gradual general improvement of surgical technique. Reduction in the degree of exenteration of the mastoid bone also produced no detectable change in the average gain.

The use of a cartilage stopple to prevent bony closure of the fenestra gave on the average about 8 decibels less *immediate* gain for speech, and in many cases did not prevent subsequent closure.

Thurlow, W. R.; Davis, H.; Silverman, S. R., and Walsh, T. E. Further Statistical Study of Auditory Tests in Relation to the Fenestration Operation, *Laryngoscope* **59:** 113, 1949.

This is the second publication and concerns a separate series of studies on the subject. In addition to the pure-tone audiometry by air conduction and tests for the threshold of speech and the maximum articulation percentage at high intensity, "the social adequacy index for hearing" was also determined. All the tests revealed good reliability and at threshold correlated closely with one anoother. The practice factor was significant only for the phonetically balanced (P. B.) words at high intensity and was notable in those patients who had initial scores below 85%. This paper should be read in order to be properly digested.

Tucci, J. H. Anesthesia in Fenestration Surgery, *Ann. Otol. Rhin. & Laryng.* **58:** 61, 1949.

Light anesthesia induced with nitrous oxide, oxygen, and ether, or intravenous anesthesia, is favored and warrants further trial as the procedure of choice in fenestration surgery.

Tumarkin, A. The Evolution of the Auditory Conducting Apparatus: A New Synthesis Based on Functional Considerations, *Proc. Roy. Soc. Med.* **41:** 877 (Section of Otology, p. 53) 1948.

The orthodox theory of the evolution of the middle ear is criticized for the following reasons:

(1) It is based too exclusively on palæontological and ontological evidence.

(2) In virtually ignoring the functional implications it accepts hypotheses which are "unreasonable" on physical and physiological grounds.

(3) It labels organs as homologous on inadequate evidence and in the face of much evidence to the contrary.

(4) It adheres to the outdated conception that homologous organs must of necessity be inherited from a common ancestor.

(5) It is exclusively preoccupied with the airborne type of middle ear. Much standard work is devoted to the problem of locating the site of the tympanic membrane. Such work is doomed to failure because the tympanic membrane in many cases did not exist as such. The drum is phylogenetically a comparatively late development and was preceded by at least 5 other auditory mechanisms.

(6) These other mechanisms (V.Q. [vestibulo-quadrate], V.Sq. [vestibulo-squamosal], V.S. [vestibulo-scapular], V.H. [vestibulo-hyoid] and V.M. [vestibulo-mandibular]) are mechanically comparatively crude but biologically they must be placed on a par with the air-conducting mechanisms V.T. [vestibulo-tympanic] and V.O. [vestibulo-ossicular]. They are alternative solutions to the problem of picking up acoustic vibrations which confronted the primitive amphibian when it first floundered on to land.

(7) Orthodox theory has no place for these alternative mechanisms and is reduced to dismissing them as "degenerate."

(8) An alternative theory is proposed in which due regard is paid to the functional implications. This leads to many deductions which are diametrically opposed to orthodox theory. It appears that this functional theory not only conforms satisfactorily to all the available ontogenetic and phylogenetic data but it also disposes quite easily of the various paradoxes which render the orthodox theory so unacceptable.

Undritz, V. F. Action of Several Chemicals on the Inner Ear, *Vestnik oto-rhino-laring.* **8:** 13, 1946.

The chemical substances were introduced into the bullae of cats, and their effect on cochlear microphonics was studied.

Varga, G. The Present State of the Otosclerosis Therapy, *Orvosok lapja* **3:** 1713, 1947.

In Hungary many operations performed according to Holmgren's method have shown that the fistula is more likely to remain open if it is placed closer to the ampulla according to Lempert's modification of the technique. Summaries of the symptomatological and pathological aspects of otosclerosis, and indications and contraindications are set forth.

Venker, J. Fenestration Operation, *Geneesk. gids.* **26:** 241, 1948.

Venker presents a review dealing particularly with the postoperative sequelae of the fenestration procedure. The improvements seen in the surgically untreated ear are explained by Gray's hypothesis, that the etiological basis of otosclerosis is a vasomotor deficiency.

Venker, J. Results of the Fenestration Operation, *Nederl. tijdschr. geneesk.* **93:** 3616, 1949.

VonDübendorfer, E. Disturbance of Taste After Fenestration Operation, *Acta oto-laryng.* **37:** 172, 1949.

The author noted no disturbances in taste after the fenestration operation, whereas after radical mastoidectomy there was a change in taste in the anterior two-thirds of the tongue corresponding to the distribution of the chorda tympani nerve. Apparently the chorda was destroyed in the radical mastoidectomies and not damaged in the fenestration operations.

Wardale, A. The Fenestration Operation for Otosclerosis, *New Zealand M. J.* **47:** 265, 1948.

Watson-Williams, E. Blue Sclerotics, Fragilitas Ossium and Deafness: Report of a Family, *Bristol Med.-Chir. J.* **65:** 82, 1948.

The pedigree of three generations is reported.

Weersma, P. Clinical and Anatomical Notes on the Fenestration Operation in Otosclerosis: Provisional Report of Results, *Nederl. tijdschr. geneesk.* **92:** 745, 1948.

Certain difficulties in performing the fenestration operation are noted, particularly in cases in which the ampulla of the horizontal semicircular canal projects into the aqueduct of Fallopius. The author cites the danger of opening the petromastoid canal and exposing the external semicircular canal. The author uses sterile amniotic membrane to cover the fistula before the flap is pressed home. Van Dishoeck, in discussing the paper, stated that considerable improvement in the hearing for the higher frequencies was sometimes noticed in a month or so postoperatively.

Weersma, P. Lempert's Otosclerosis Operation, *Nederl. tijdschr. geneesk.* **91:** 126, 1947.

Weder, A. Indication and Prognosis in Fenestration Operations for Otosclerosis, *Schweiz. med. Wchnschr.* **78:** 1097, 1948.

Good results were obtained in 24 patients, but the time following the operation was too short to be certain of permanent results.

Wilson, T. G. The Surgical Treatment of Deafness, *Irish J. M. Sc.*, p. 33, 1947.

A short historical sketch of the fenestration operation from Kessel (1876) through Jenkins (1914), Simson Hall, and Lempert is given. It was found that

the postaural route is advantageous and that in a fairly large proportion of cases a meatal plastic procedure is not required. Wilson constructs the tympanomeatal flap in the usual way. He uses a binocular dissecting microscope with magnifications of 0.8 to 10. Much remains to be done before the fenestration operation can be standardized. It is still in the early stages of its evolution and may ultimately differ greatly from its present form.

Winter and Guiot. Diffuse Osteitis of the Cranium with Progressive Deafness, *Rev. oto-neuro-oftal.* **19:** 301, 1947.

A case of diffuse cranial osteitis with bilateral progressive deafness is described. The question is raised whether there was any correlation between the osteitis and the otosclerosis, and whether the fenestration operation would be of any service in such cases.

Wirth, E. The Results of the Fenestration Operation in U. S. A. and Their Importance for the Practicing Otologist, *Ztschr. Hals- usw. Heilk.* **1:** 187, 1948.

A general review is presented.

Woodman, DeG. The Fenestration Operation for Otosclerosis: A Survey of Experience with 75 Cases Together with a Study of the Effect on the Contralateral Ear, *Laryngoscope* **59:** 1299, 1949.

A report is given of 75 fenestration operations done with a slightly modified Lempert technique. An unusual accident was the removal of a metallic foreign body from within the labyrinth with the aid of an electromagnet. In one patient who died of massive thrombosis in the pulmonary, cerebral, and leg veins a few days postoperatively, photomicrographs were obtained of the fenestra and the flap. The author believes that an improvement of hearing in the surgically untreated ear is due to some central tonic effect of the operation.

Woods, R. R. Bone Conduction in Otosclerosis, *Brit. M. J.* **1:** 754, 1948.

In a letter to the editor the author states that he has never seen the hearing of the ear not subjected to fenestration altered in any way, for either air conduction or bone conduction.

Woods, R. R. Some Observations on Bone Conduction Following the Fenestration Operations, *J. Laryng. & Otol.* **62:** 22, 1948.

In one case, although the fenestra closed, there was no significant change in the bone conduction. In five cases there was an average decibel increase of 29.4 for air conduction and 14.2 for bone conduction on the side operated on; the other ear was unaffected. The author believes that bone-conduction loss cannot be due entirely to cochlear degeneration. He remarks that stapes fixation, in addition to preventing vibrations to the labyrinth, impedes perilymph mobility and so impairs cochlear function. The fenestration operation mobilizes perilymph and, therefore, brings about an improvement in function.

Woods, R. R. The Fenestration Operation for Otosclerosis, *Irish J. M. Sc.*, p. 71, 1949.

Work, W. P. Dissecting Microscope for Temporal Bone Surgery, *Tr. Am. Acad. Ophth.* **53:** 370, 1949.

Wullstein, H. Results of 100 Shambaugh-Passe Fenestration Operations in Otosclerosis and Adhesive Otitis, *Deutsche med. Wchnschr.* **74:** 1549, 1949.

The results obtained with the methods of Holmgren and Lempert proved very unsatisfactory because of early closure of the fistula. Shambaugh's method of "enchondralization" gave better results. The indications for operation and the techniques are described.

Zwislocki, J. Theory of Cochlear Mechanism: Qualitative and Quantitative Analysis, *Acta oto-laryng.*, supp. 72, p. 1, 1948.

The following paragraphs are from the author's summary:

The general conditions for the propagation of vibrations in the cochlea of the ear are described on the basis of anatomical data. The problem is shown to be of a predominantly hydrodynamic nature. It exhibits a great similarity to that of surface waves arising at the interface between two liquids. The difference lies in the properties of the surface, which, in the case of the cochlea, is represented by the ductus cochlearis. In contrast to an ideal interface, in which only capillary forces with an elastic character are present, the ductus cochlearis possesses both mass and damping. In addition, its elasticity is subject to local variations, a fact which is responsible for the specific character of vibrations occurring in the cochlea.

On condition that the waves are long, as may be assumed on the basis of the experiments of G. von Békésy, it is possible to deduce a dynamic differential equation containing all the factors which influence the process of vibration. These include the density of the perilymph and its viscosity, the dimensions of the canal, and the impedance of the ductus cochlearis. The above-mentioned differential equation is independent of the shape of the canal and the course of the vibrations with respect to time.

For a more detailed description of the dynamic relationships, the determination of the impedance of the ductus cochlearis is necessary. The elasticity and the damping then follow from the experiments carried out by von Békésy. The mass is calculated from the anatomical data. While the damping and the mass can be regarded as constant for the entire length of the canal, the elasticity diminishes rapidly as the distance from the base of the cochlea increases.

On the basis of the known experiments and the differential equation deduced for the cochlea, the existing theories of hearing are subjected to a critical discussion. From this it follows that none of these theories can be regarded as adequate.

An approximate solution of the differential equation of the cochlea leads to a result which is in fundamental agreement with the results of the known experiments. It shows that the amplitude and wave length of the waves which are propagated in the cochlea change without discontinuity. A single local vibration maximum is produced. This requires neither wave reflection nor resonance within the ductus cochlearis. The maximum is caused by the combined effects of the flexibility of the basilar membrane and its damping. It occurs at a point where the impedance of the ductus cochlearis possesses an elastic character and, on account of the presence of damping, cannot arise at the point of resonance. The mass of the ductus cochlearis plays such a small part that one is justified in neglecting it.

The omission of the mass and the introduction of the remaining impedance magnitudes enable a nearly exact solution of the differential equation of the cochlea to be made. The numerical calculation leads to results which correspond both qualitatively and quantitatively with the experimental findings.

What is important is the occurrence of a flat local vibration maximum which with increasing frequency becomes displaced from the apex of the cochlea toward its base and makes possible a rough resolution of the frequencies. It, therefore, appears necessary that there should be a finer frequency analysis in the nervous apparatus.

The high impedance calculated for the entrance to the cochlea enables the complicated mechanism of the middle ear to be understood.

The theoretical velocity of propagation of the waves in the cochlea reaches 45 m. per second at the oval window and decreases rapidly as the distance from it increases.

The eddies which, as demonstrated by von Békésy, occur at the place of maximum vibration are shown to have a mathematical foundation. They are to be attributed to quadratic terms in the hydrodynamic equations, which, at the amplitudes occurring in acoustics, represent small magnitudes of the second order. Accordingly, the eddies are to be regarded as a secondary phenomenon having no noteworthy influence upon the other processes.

A brief consideration of the mechanical factors causing stimulation of the sensory cells calls attention to the forces of mass arising in the ductus cochlearis.

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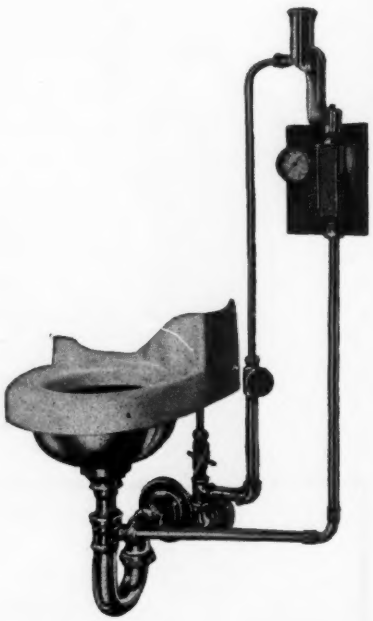

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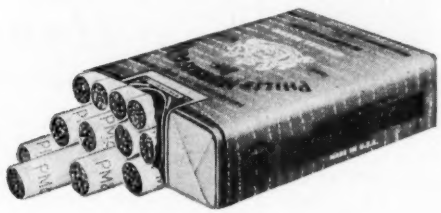

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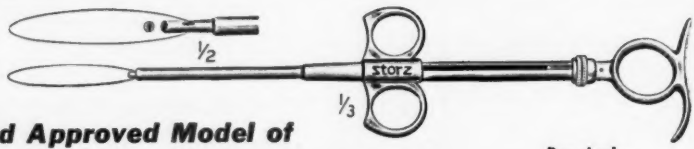

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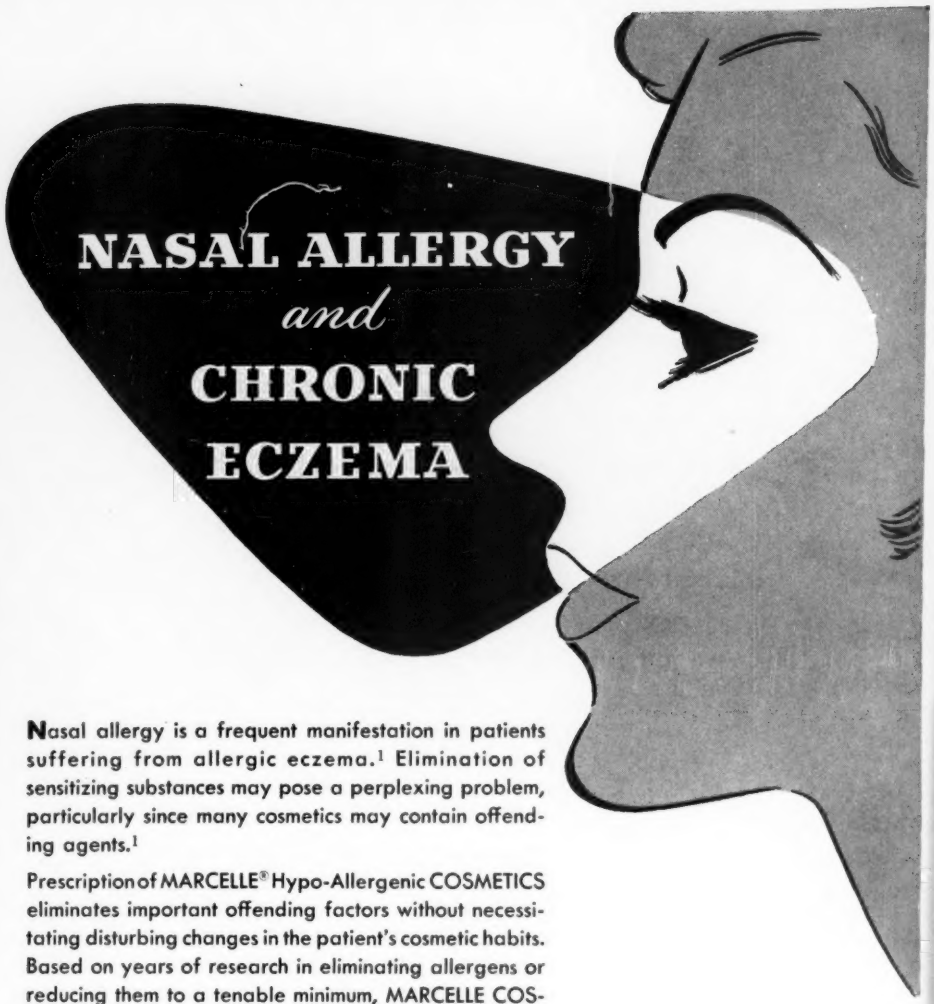

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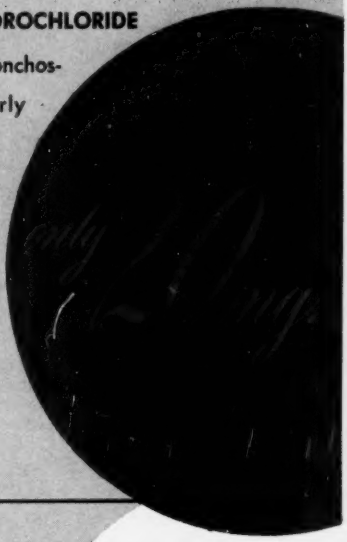

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